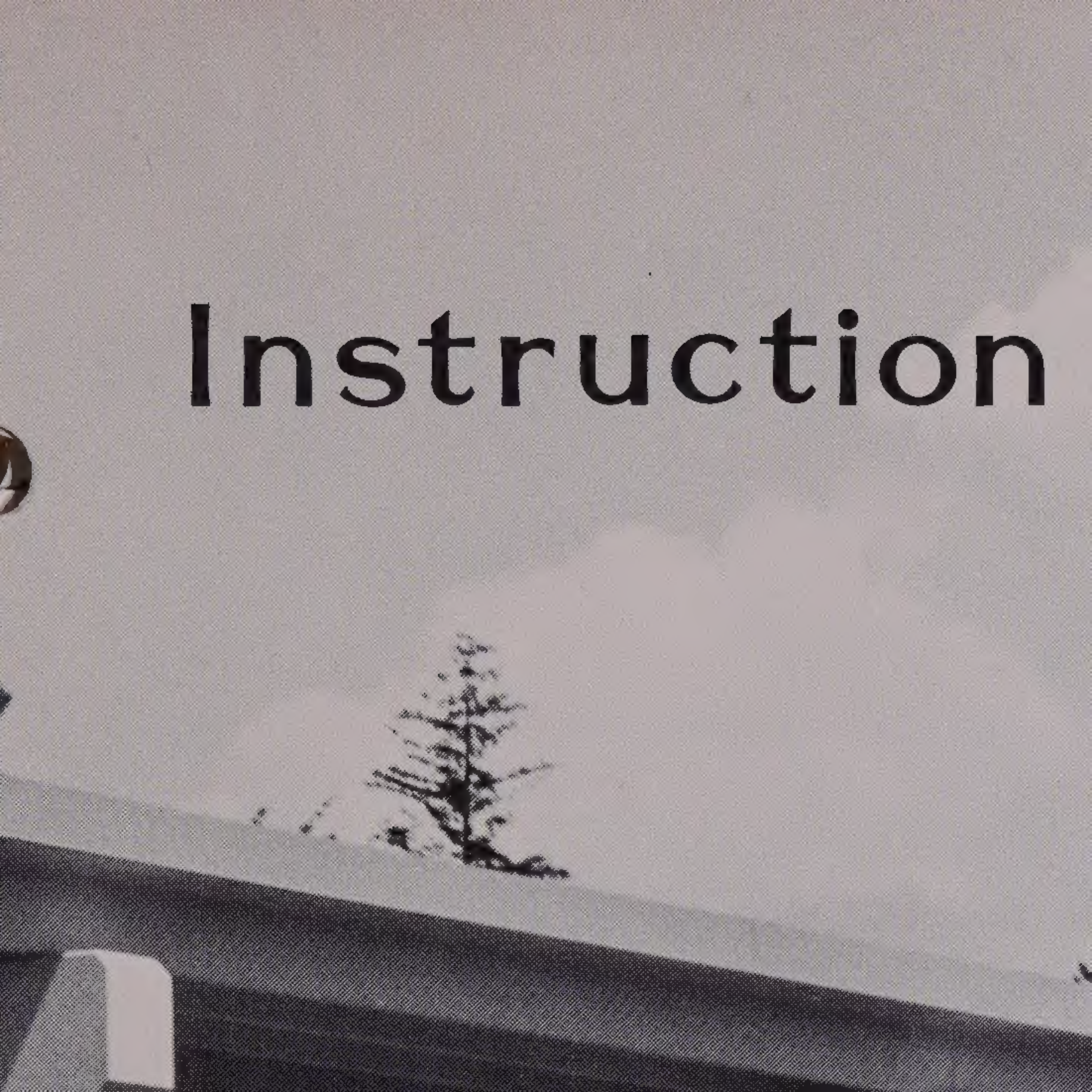
Instruction



JOHN FLUKE MFG. CO., INC.

P. O. Box 43210
Mountlake Terrace, Washington 98043

S/N 0845056

MODEL

8800A

DIGITAL MULTIMETER

REV. 1 - 5/75 Rev 2 7/76 Rev. 3 - 4/77

369405

NOVEMBER - 1974

WARRANTY

The JOHN FLUKE MFG. CO., INC.* warrants each instrument manufactured by them to be free from defects in material and workmanship. Their obligation under this Warranty is limited to servicing or adjusting an instrument returned to the factory for that purpose, and to making good at the factory any part or parts thereof; except tubes, fuses, choppers and batteries, which shall, within one year after making delivery to the original purchaser, be returned by the original purchaser with transportation charges prepaid, and which upon their examination shall disclose to their satisfaction to have been thus defective. If the fault has been caused by misuse or abnormal conditions of operations, repairs will be billed at a nominal cost. In this case, an estimate will be submitted before work is started, if requested.

If any fault develops, the following steps should be taken:

1. Notify the John Fluke Mfg. Co., Inc.,* giving full details of the difficulty, and include the Model number, type number, and serial number. On receipt of this information, service data or shipping instructions will be forwarded to you.

2. On receipt of the shipping instructions, forward the instrument prepaid, and repairs will be made at the factory. If requested, an estimate will be made before the work begins, provided the instrument is not covered by the Warranty.

"The foregoing warranty is in lieu of all other warranties, express or implied, including but not limited to, any implied warranty of merchantability, fitness or adequacy for any particular purpose or use. Fluke shall not be liable for any special, incident or consequential damages."

SHIPPING

All shipments of John Fluke Mfg. Co., Inc.* instruments should be made via United Parcel Service or "Best Way"** prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be thoroughly inspected immediately upon receipt. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to John Fluke Mfg. Co., Inc.* Upon receipt of this report, you will be advised of the disposition of the equipment for repair or replacement. Include the model number, type number, and serial number when referring to this instrument for any reason.

The John Fluke Mfg. Co., Inc.* will be happy to answer all application questions which will enhance your use of this instrument. Please address your requests to: JOHN FLUKE MFG. CO., INC., P.O. Box 43210, MOUNTLAKE TERRACE, WASHINGTON 98043*.

* For European customers: FLUKE (Nederland) B.V.
Ledeboerstraat 27
Tilburg, Netherlands

** For European customers, Air Freight prepaid.

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Section 1
Introduction & Specifications

1-1. INTRODUCTION

1-2. The Model 8800A Digital Multimeter is a 5½ digit meter providing automatic or manual ranging for five ranges of dc voltage inputs, four ranges of ac voltage inputs and six ranges of resistance measurements. The dual-slope method of analog-to-digital (A/D) conversion, coupled with self zeroing, eliminates the display uncertainties caused by inherent A/D zero offsets. A single, digital integrated circuit uses the A/D output signal to produce the proper digit, decimal point and polarity information applied to the LED display.

1-3. The piano-key type control switches on the front panel make the light weight unit easy to operate. The unit's carrying handle also doubles as a tilt stand to provide convenient viewing angles for bench use. A flashing display of 188888, used for indicating an input overrange condition, also provides a convenient way of checking each digit for proper segment illumination.

1-4. OPTIONS

1-5. The basic 8800A multimeter can be equipped at the factory with a Data Output Unit (DOU) option. The multimeter with the DOU option installed, designated the 8800A-02, allows the unit to supply the display information to data acquisition systems or digital printer equipment.

1-6. ACCESSORIES

1-7. Accessories are available for use with all 8800A digital multimeters. These accessories are listed in Table 1-1.

Table 1-1. 8800A ACCESSORIES

ACCESSORY MODEL NO.	DESCRIPTION
M00-200-625	Rack Mounting Kit, Center
A80	Deluxe Test Lead Kit
80K-40	High Voltage Probe
82RF	High Frequency Probe (100 kHz to (500 MHz)
81RF	High Frequency Probe (100 kHz to 100 MHz ±1 of B)
80T-150	Temperature Probe

1-8. SPECIFICATIONS

1-9. Specifications for the Model 8800A are presented in Table 1-2, under headings of DC VOLTAGE, AC VOLTAGE, OHMS, and GENERAL. Specifications for options are listed under each option heading.

Table 1-2. SPECIFICATIONS

DC VOLTAGE

Ranges	±200 mV, ±2V, ±20V, ±200V, ±1200V
Accuracy:	(24 Hr. 23°C ±1°C)
200 mV range	±(0.008% of input + 0.0025% of range)
2V - 200V range	±(0.005% of input + 0.001% of range)
1200V range	±(0.005% of input + 0.002% of range)
	(90 days 18°C - 28°C)
200 mV range	±(0.01% of input + 0.005% of range)
2V - 200V range	±(0.01% of input + 0.0015% of range)
1200V range	±(0.01% of input + 0.003% of range)
Temperature Coefficient:	(0°C - 18°C, 28°C to 50°C)
200 mV range	±(0.0007% of input + 0.0013% of range)/°C
2V range	±(0.0007% of input + 0.0003% of range)/°C
20V - 200V range	±(0.0007% of input + 0.0002% of range)/°C
1200V range	±(0.0007% of input + 0.0003% of range)/°C

DC Input Resistance

200 mV - 20V range	⩾ 1000 megohms
200V - 1200V range	10 megohms

Normal Mode Noise Rejection	⩾ 60 db @ 50 Hz and 60 Hz
Common Mode Noise Rejection	⩾ 120 db @ dc to 60 Hz (with 1kΩ in either lead)
Resolution	1 μV on 200 mV range
Ranging	Full autoranging or manual ranging
Polarity	Automatic bipolar, + or — display
Overload Protection	200V, 1200V range; ±1200V dc, 1700V, peak ac
	200 mV - 20V range; ±1000V dc, 1400V, peak ac
Offset Current (at 23°C)	Less than 15 pA on any range. Temperature coefficient of ±5 pA/°C
Zero Stability	Better than 10 μV for 90 days after one hour warmup
Response Time to Rated Accuracy within Range	1 second maximum to displayed input

AC VOLTAGE

Ranges	2V, 20V, 200V, 1200V
Accuracy: 2V - 200V ranges (100% to .1% of range)	
	(24 Hour, 23°C ±1°C)
100 Hz - 10 kHz	±(0.05% of input + 0.005% of range)
50 Hz - 100 Hz, 10 kHz - 20 kHz	±(0.1% of input + 0.01% of range)
30 Hz - 50 Hz, 20 kHz - 100 kHz	±(1.0% of input + 0.03% of range)

Table 1-2. SPECIFICATIONS

	(90 days 18°C – 28°C)
100 Hz - 10 kHz	±(0.1% of input + 0.005% of range)
50 Hz - 100 Hz, 10 kHz - 20 kHz	±(0.25% of input + 0.01% of range)
30 Hz - 50 Hz, 20 kHz - 100 kHz	±(1.0% of input + 0.03% of range)
	1200V range (100% to .1% of range)
	(90 days 18°C - 28°C)
	(1V to 500V input)
100 Hz - 10 kHz	±(0.15% of input + 0.01% of range)
30 Hz - 100 Hz, 10 kHz - 20 kHz	±(0.25% of input + 0.02% of range)
	(500V to 1200V input)
100 Hz - 10 kHz	±(0.3% of input + 0.01% of range)
30 Hz - 100 Hz, 10 kHz - 20 kHz	±0.5% of input + 0.02% of range)
	20 kHz maximum response on 1200V range
Temperature Coefficient:	
(0°C - 18°C, 28°C - 50°C)	±(0.008% of input +0.001% of range)/°C, 2V - 200V range ±(0.008% of input +0.002% of range)/°C, 1200V range
Input Impedance	2 megohms shunted by less than 100 pF
Response Time to Rated Accuracy within Range	1.5 second maximum to displayed input
Ranging	Full autoranging or manual ranging
Overload Protection	1200V rms maximum, not to exceed 2 x 10^7 volt hertz product. 20 kHz maximum on 1200V range.
Resolution	10μV on 2V range
OHMS	
Ranges	200Ω, 2kΩ, 20kΩ, 200kΩ, 2000kΩ, 20MΩ
Resolution	1mΩ on 200 ohm range
Configuration	Four-terminal measurement on all ranges
Ranging	Full autoranging or manual range
Accuracy:	(24 Hr, 23°C ±1°C)
200Ω range	±(0.01% of input + 0.0025% of range)
2kΩ - 200kΩ range	±(0.008% of input + 0.001% of range)
2000kΩ range	±(0.02% of input + 0.001% of range)
20MΩ	±(0.05% of input + 0.001% of range)
	(90 day, 18°C - 28°C)
200Ω range	±(0.02% of input + 0.005% of range)
2kΩ - 200kΩ range	±(0.01% of input + 0.0015% of range)
2000kΩ range	±(0.05% of input + 0.0015% of range)
20MΩ range	±(0.2% of input + 0.0015% of range)
Temperature Coefficient:	
200Ω range	±(0.001% of input + 0.0013% of range)/°C
2kΩ - 200kΩ range	±(0.001% of input + 0.0003% of range)/°C
2000kΩ range	±(0.005% of input + 0.0003% of range)/°C
20MΩ range	±(0.02% of input + 0.0003% of range)/°C

Table 1-2. SPECIFICATIONS

Range	200Ω	2kΩ	20kΩ	200kΩ	2000kΩ	20MΩ
Maximum Current Through Unknown	1 mA	1 mA	250μA	25μA	2.5μA	0.25μA

Overvoltage Protection	250V rms or dc, applied continuously to any range
Maximum Open Circuit Voltage	3.3 volts
Response Time:	
200Ω - 200kΩ range	1.0 seconds maximum to displayed input
2000kΩ and 20MΩ range	3.0 seconds maximum to displayed input
GENERAL	
Function	Selected via front panel controls
Range	Full autoranging or manually selectable via front panel controls
Autorange Rate	600ms maximum per range change
Display	7 segment 0.3" LED display, automatic decimal location
Reading Rate	2.5 readings per second, within the same range
Storage Temperature	–40°C to 75°C
Operating Temperature	0°C to +50°C
Humidity Range	70% R.H., +35°C to +50°C 80% R.H., +5°C to +35°C
Overload Indication	Flashing Display of +188888 (built-in segment test of LED display) for out of range indication
Shock and Vibration	Meets pertinent requirements of MIL-T-2100L and MIL-E-16400F
MTBF	10,000 hours calculated, minimum
Maximum Common Mode Voltage	1000V dc or peak ac
Maximum LO to GUARD voltage	100V dc or peak ac
Power	110/230V ac ±10%, 50 or 60 Hz, 8 watts
Size	Maximum deminsions (see Figure 1-1) 3.16" high x 9.0" wide x 14.2" long (8.03 cm x 22.86 cm x 36.07 cm)
Weight	6.5 lbs (3.0 kg)
Data Output Unit, (Option –02)	
Available Data	Digits, Polarity (both logic Senses), and Range.
Data Output (form)	Isolated BCD, with compatible TTL/DTL levels.
Data Coding	8-4-2-1 BCD positive true parallel (negative true easily obtained by changing output buffers)
Logic Levels	"1" = +5V, "0" = OV
Drive Capability	All outputs can drive a min. of two TTL loads (i.e., sink 3.2 mA)
Flags	Busy, not busy, and Overload
Controls	External trigger (negative-going edge triggers); External trigger enable (Logic "1" enables external, trig. Logic "0" causes data update at the internal sample rate of approximately 2.5/second); +5V reference.

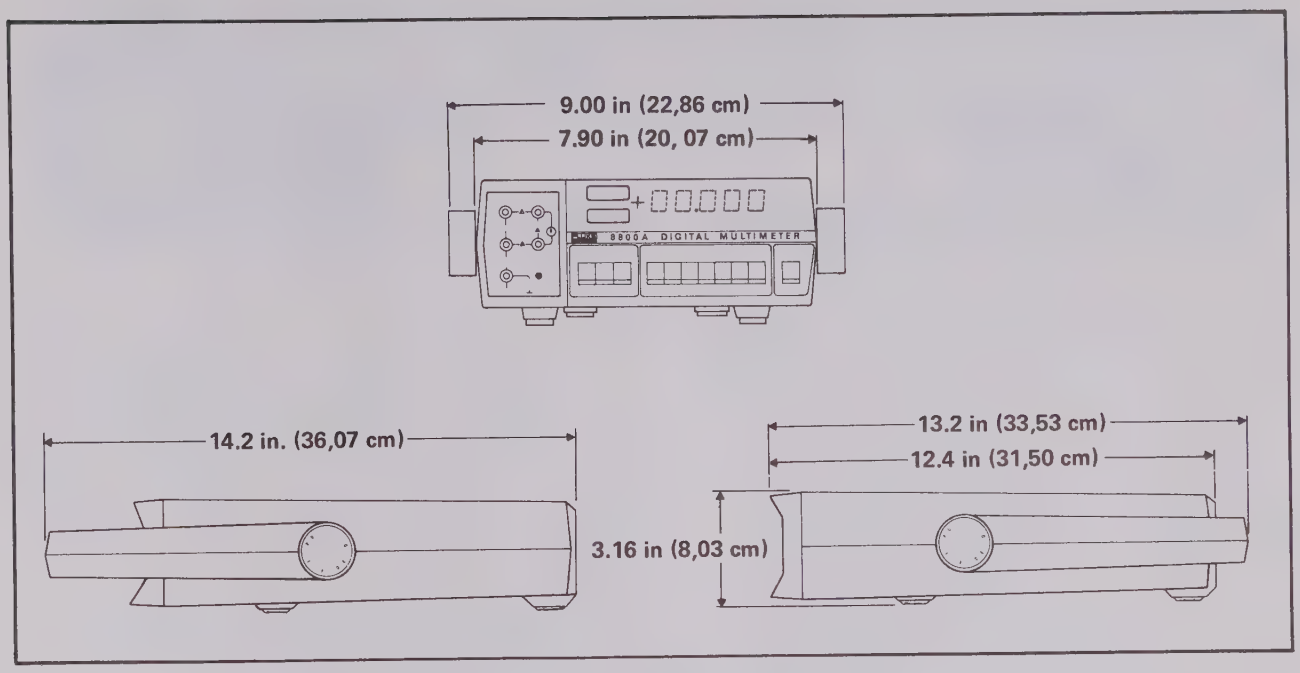
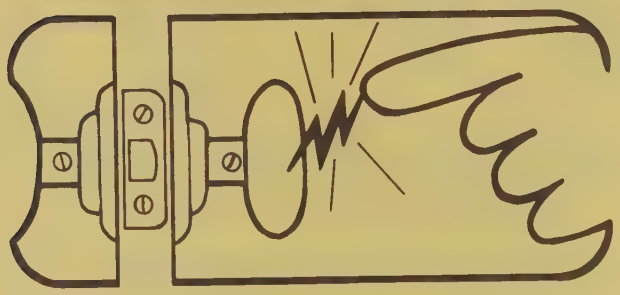


Figure 1-1. MODEL 8800A OUTLINE DRAWING

static awareness

A Message From

John Fluke Mfg. Co., Inc.

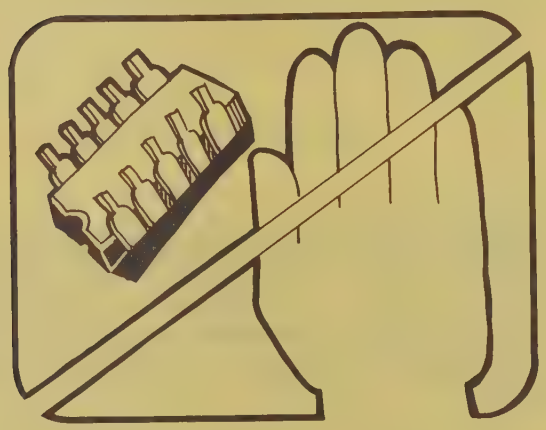


Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

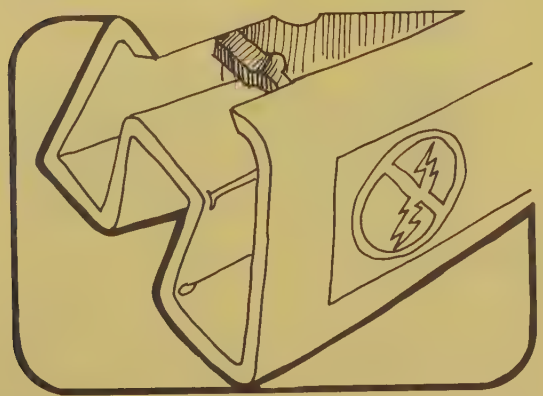
1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, and packaging and bench techniques that are recommended.

The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol "⊗".

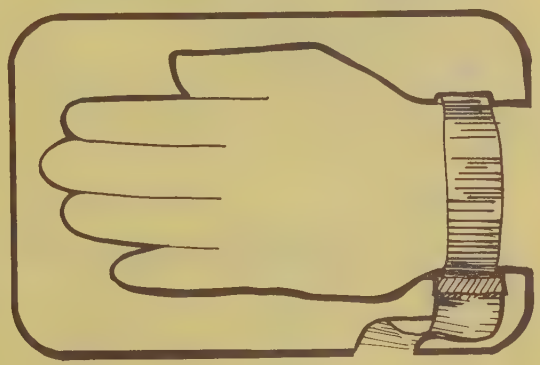
The following practices should be followed to minimize damage to S.S. devices.



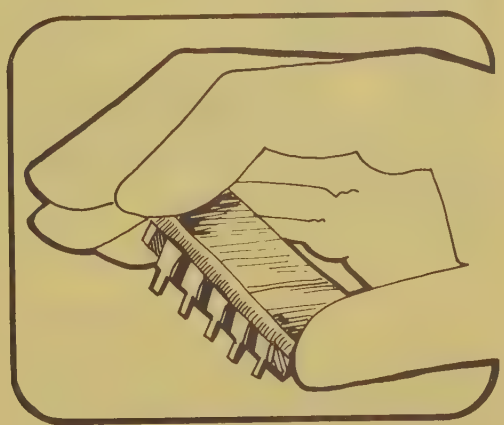
1. MINIMIZE HANDLING



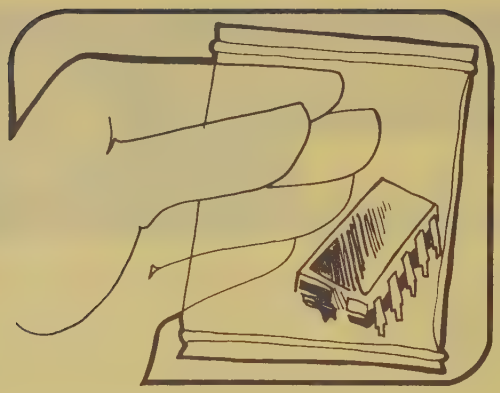
2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.



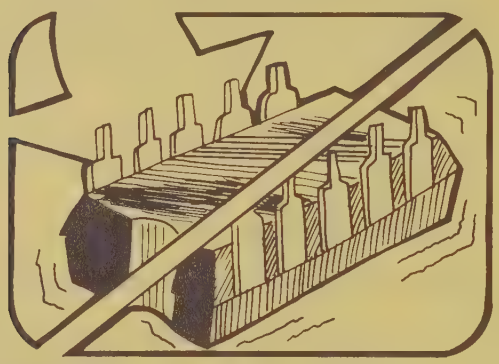
3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES



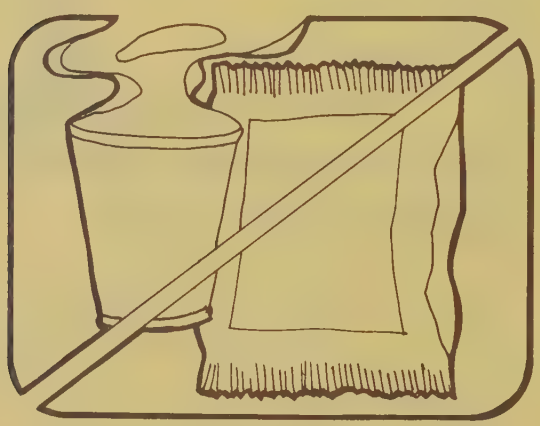
4. HANDLE S.S. DEVICES BY THE BODY



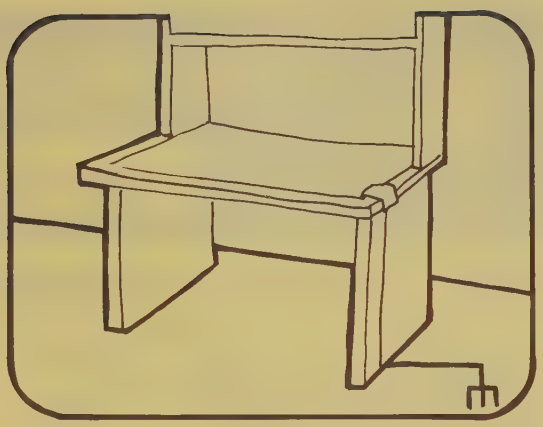
5. USE ANTI-STATIC CONTAINERS FOR HANDLING AND TRANSPORT



6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE



7. AVOID PLASTIC, VINYL AND STYRAFOAM IN WORK AREA



8. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION

9. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.

10. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

Anti-static bags, for storing S.S. devices or pcbs with these devices on them, can be ordered from the John Fluke Mfg. Co., Inc.. See section 5 in any Fluke technical manual for ordering instructions. Use the following part numbers when ordering these special bags.

John Fluke Part No.	Bag Size
453522	6" x 8"
453530	8" x 12"
453548	16" x 24"
454025	12" x 15"

Section 2
Operating Instructions

2-1. INTRODUCTION

2-2. This section contains information regarding the installation and operation of the Model 8800A. The contents of this section should be read before operating the digital multimeter. Should any difficulties be encountered during operation, contact your nearest John Fluke Sales Representative or the John Fluke Mfg. Co., Inc. P.O. Box 43210, in Mountlake Terrace, Washington, 98043. Telephone (206) 774-2211. A list of Sales Representatives is located in Section 7 of the manual.

2-3. SHIPPING INFORMATION

2-4. The Model 8800A was packaged and shipped in a foam packed cardboard carton. After unpacking the unit, a thorough inspection should be made to note any damage that may have occurred in transit.

2-5. If reshipment becomes necessary the instrument should be repackaged in the original container. If the original container is not available, a new one can be obtained from the John Fluke Mfg. Co., Inc. Please reference the model number (8800A) when requesting a new shipping container.

2-6. INPUT POWER

WARNING
LETHAL VOLTAGES MAY BE PRESENT AT THE LINE POWER INPUT CONNECTOR AND THE POWER SUPPLY PCB ASSEMBLY WHEN THE 8800A IS CONNECTED TO LINE POWER.

2-7. The Model 8800A may be powered from either 115 volts, 50 or 60 Hz, or 230 volts, 50 or 60 Hz. A slide switch located inside, on the main pcb of the unit, allows either configuration of input voltage to be selected. For selection of the input voltage, refer to the following procedure:

a. Remove line cord.

b. Remove unit from case, (See paragraph 4-7). The line voltage switch is a slide switch located on the main pcb toward the rear.

c. Refer to rear panel decal to check the appropriate line voltage.

2-8. RACK INSTALLATION

2-9. The Model 8800A can be mounted in a standard 19-inch equipment rack. A rack mounting kit (M00-200-625) is available to allow center mounting of the unit. Instructions for attaching the rack mount to the unit are supplied with each kit, and in section –6 of this manual.

2-10. OPERATING FEATURES

2-11. The function and location of the Model 8800A controls and indicators are provided in Figure 2-1 and Table 2-1.

2-12. OPERATING NOTES

2-13. The following paragraphs describe various conditions which should be considered before operating the Model 8800A.

2-14. AC Line Connection

2-15. The input power cord is a three-prong polarized connector which permits connection to 115 or 230 volts, 50 or 60 Hz line power. Insure that the ground pin on the power cord is connected to a high quality earth ground.

2-16. Operating Instructions

2-17. Five input terminals (INPUT - Ω SENSE, HI and LO; Ω SOURCE, HI and LO; and a GUARD) provided connection to the voltage source or resistance under measurement. Table 2-2 provides instructions for the proper connections and control setting for each multimeter function.

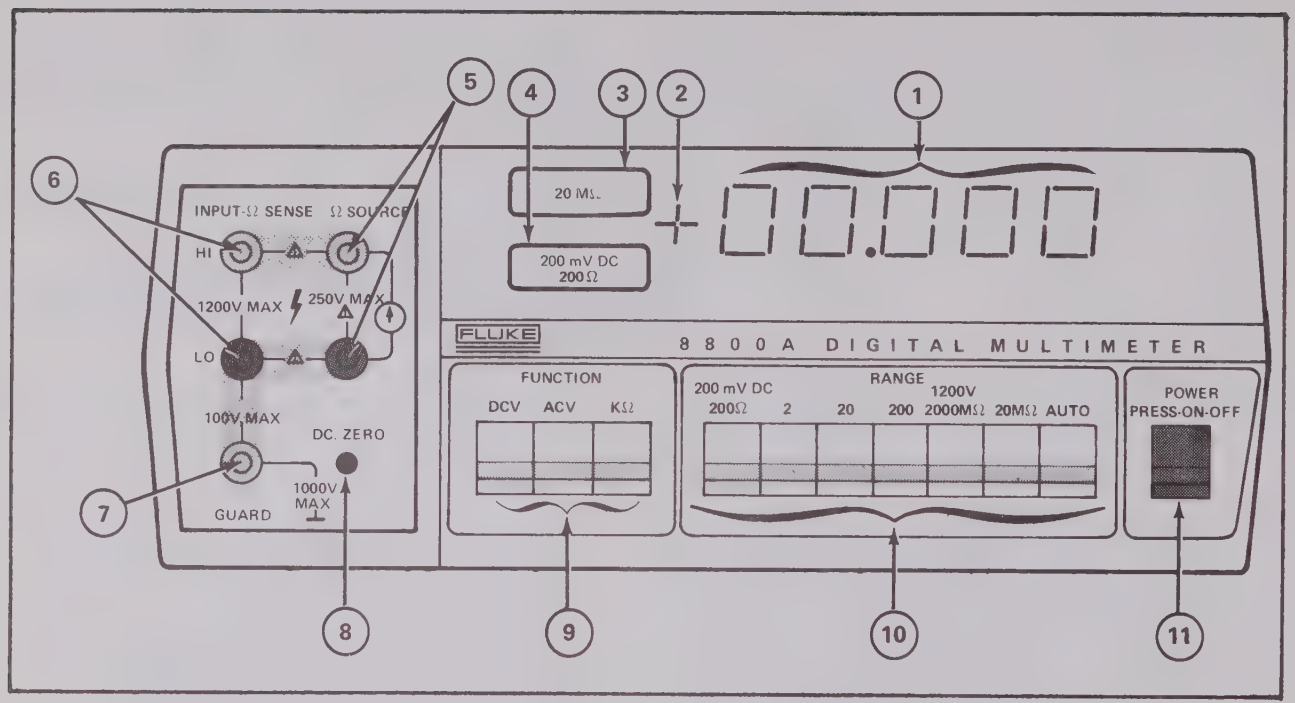


Figure 2-1. 8800A CONTROL AND INDICATOR LOCATIONS

Table 2-1. 8800A CONTROL AND INDICATOR FUNCTIONS

FIG 2-1 REF. NO.	NAME	FUNCTION
1	LED display	Provides a digital readout of the value of applied inputs.
2	Polarity indicator	Displays a + (positive) or — (negative) polarity indication for corresponding dc voltage inputs.
3	20 MΩ indicator	LED indicator lights when 20 MΩ RANGE is selected.
4	200 mVDC, 200Ω indicator	LED indicator lights when 200 mVDC, 200Ω range is selected
5	Ω SOURCE HI and LO terminals	Provide current through unknown resistance to be measured in KΩ FUNCTION.
6	INPUT - Ω SENSE HI and LO terminals.	Provides connections for ACV and DCV FUNCTION inputs and Ω SENSE input in KΩ FUNCTION.
7	GUARD terminal	Provides connection to internal voltmeter guard.
8	DC ZERO adjustment	Adjusts 8800A display for zero reading in ZERO ADJUST procedures. (See section —4, precalibration procedure)
9	FUNCTION pushbuttons	Selects the DCV, ACV or KΩ mode of operation.
10	RANGE pushbuttons	Selects discrete range or AUTO range in each function.
11	POWER pushbutton	Turns instrument on or off.

2-18. Input Terminal Voltage Limits ⚠

2-19. The maximum voltage limits that may be applied between adjacent input terminals, without causing damage to the 8800A, are provided below. In some cases the inter-terminal voltage limit will change when the function of the multimeter is changed. Do not exceed the limits given.

NOTE!

The ⚠ symbol indicates that additional information is provided in the manual to prevent damage to the instrument.

a. INPUT - Ω SENSE HI to INPUT - Ω SENSE LO; 1000V dc max on the 200 mV - 20V ranges DC, 1200V dc max on the 200V - 1200V ranges DC. 1200V rms max on all ranges AC. 250V dc or rms when in the KΩ function.

b. Ω SOURCE HI to Ω SOURCE LO; When the KΩ function is selected, the maximum voltage that can be applied between the Ω SOURCE HI and LO terminals is 250V. 1200V max. when the VAC or VDC function is selected and the shorting links between the two HI and two LO terminals are used.

c. INPUT - Ω SENSE HI to Ω SOURCE HI and INPUT - Ω SENSE LO to Ω SOURCE LO; 0.5V max. when shorting links are removed.

CAUTION

Shorting link between INPUT - Ω SENSE HI and Ω SOURCE HI, and shorting link between INPUT - Ω SENSE LO and Ω SOURCE LO must be installed except when making 4 - terminal ohms measurements.

d. INPUT - Ω SENSE LO to GUARD; 100V max.

e. GUARD to earth ground; 1000V max.

CAUTION

Shorting link from GUARD to INPUT - Ω SENSE LO must be installed except when making guarded measurements.

2-20. Guarded Measurements

2-21. The 8800A employs a system of shields and guards that function, when properly connected, to minimize common mode to normal mode signal conversion. The common mode signal, represented by Ecm in Figure 2-4, is the difference in potential between the outer case ground of the multimeter and the ground of the voltage source being measured. This common mode potential can be caused by voltage differences in the ground lines or currents induced in them.

2-22. The input lead and terminal link configuration illustrated in Figure 2-4 is for unguarded measurements; the most commonly used method. In this configuration it is possible for the common mode voltage (Ecm) to supply

Table 2-2. MEASUREMENT INSTRUCTION

MEASUREMENT TO BE MADE	8800A			REMARKS
	FUNCTION	RANGE	INPUT CONNECTIONS	
± DC Voltage	VDC	200 mV, 2, 20 200, 1200 or AUTO	INPUT · Ω SENSE, HI to LO	8800A automatically selects highest range for chosen function if range is not manually called, or AUTO selected.
AC Voltage	VAC	2, 20, 200, 1200 or AUTO		
RESISTANCE	KΩ	200Ω, 2, 20, 200, 2000 kΩ 20 MΩ or AUTO		Use 4-terminal ohms measurement if desired. On all ranges the Ω SOURCE terminals must be connected either remotely (see Figure 2-2) or with shorting links (see Figure 2-3) to the INPUT - Ω SENSE terminals for all resistance measurements.

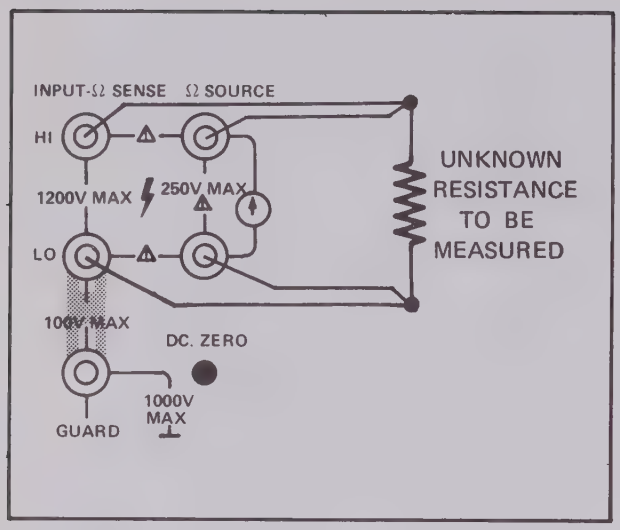


Figure 2-2. INPUT TERMINAL CONNECTIONS FOR 4-TERMINAL MEASUREMENTS

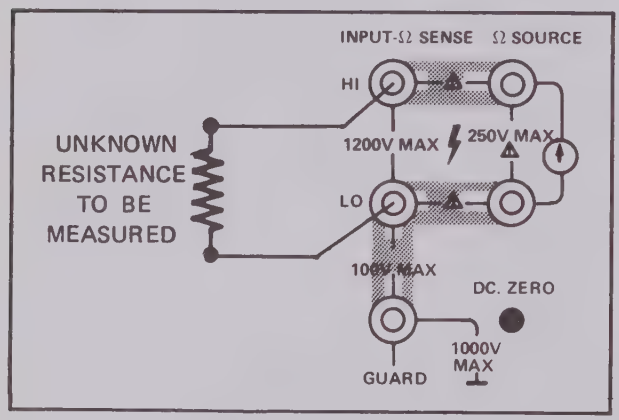


Figure 2-3. INPUT TERMINAL CONNECTIONS FOR 2-TERMINAL MEASUREMENTS

common mode current (Icm) via the test lead on the low input terminal, the guard to low-input shorting link, through the inner guard to outer case stray leakage paths, and back to the common mode source. This common mode current flow will cause a normal mode voltage drop across the lead resistance that will add to or subtract from the input voltage being measured. When the lead resistance increases (caused by long input leads or poor connections) or the common mode voltage increases, the common mode signal converted to a normal mode voltage can cause a noticeable error in the multimeter display.

2-23. The guard terminal on the 8800A front panel can be connected in a way that provides a signal path for the common mode current that does not go through the input leads carrying the normal mode voltage signal. These terminal connections, illustrated in Figure 2-5, provide for a guarded measurement of the applied input.

2-24. Guarded measurements can be obtained when the following conditions are met:

1. Remove link connecting guard terminal and low input.
2. Connect shield of the input leads to the guard terminal.
3. Connect input end of the shield to same point as the input low lead.

2-25. The above conditions, when met, will effectively extend the inner guard of the instrument out to the end of the input leads. The common mode current will then flow through the shield on the input leads to the guard terminal, across the inner guard to the outer case stray leakage paths, and back to ground. Therefore the current no longer flows through the input lead to create the error voltage.

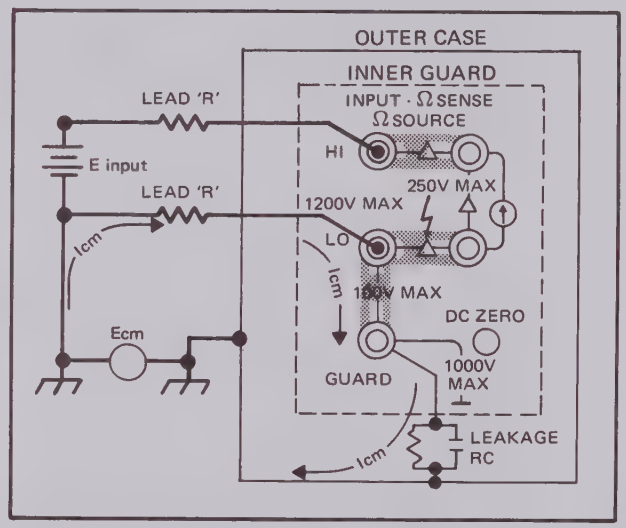


Figure 2-4. UNGUARDED MEASUREMENT TERMINAL CONFIGURATION

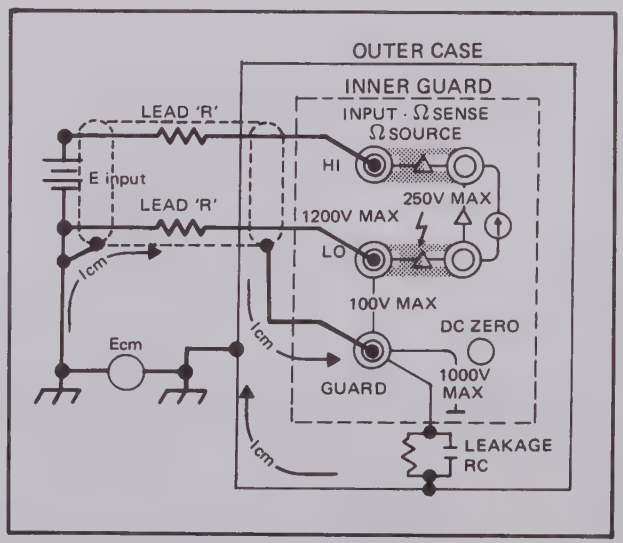


Figure 2-5. GUARDED MEASUREMENT TERMINAL CONFIGURATION

Section 3
Theory of Operation

3-1. INTRODUCTION

3-2. The theory of operation for the Model 8800A is arranged under two major headings. The first, titled OVERALL FUNCTIONAL DESCRIPTION, discusses the overall operation of the instrument in terms of the functional relationship of the major circuits. The second heading is titled SIMPLIFIED CIRCUIT ANALYSIS and deals with the internal operation of each major circuit in more detail. Block diagrams and simplified circuit diagrams are included in this section. The complete schematic diagrams are located in Section 8 of this manual.

3-3. OVERALL FUNCTIONAL DESCRIPTION

3-4. Introduction

3-5. The 8800A circuitry can be divided into three major sections. The first of the three sections, termed the Input Signal Conditioners, (see Figure 3-1) comprises the Ohms Converter, VDC Buffer and AC Converter. The second section is the A/D (analog-to-digital) Converter and the third is the Control and Display section. The basic operational relationship of these functional areas is shown in Figure 3-1 and will be discussed in the following paragraphs.

3-6. Input Signal Conditioners

3-7. The term, input signal conditioner, describes the basic function of the three subsections grouped under it. The ohms converter, AC converter and VDC buffer provided the A/D converter with a dc analog voltage representative of the input (ac volts, dc volts, or resistance) applied to the instrument. The basic path that each input signal follows as it is conditioned for the A/D converter is illustrated in Figure 3-1.

3-8. When making a dc voltage measurement the unknown voltage applied to the INPUT HI and LO terminals is directed to the DCV Buffer. The buffer then either amplifies the input voltage (200 mV range), passes the entire input voltage (2V range) or divides the input voltage by some power of ten (20, 200 and 1200V ranges), so that a "conditioned" signal of two volts dc at the A/D Converter is representative of a full scale instrument input for all ranges.

3-9. AC voltage inputs applied to the INPUT HI and LO terminals are directed through closed switch contacts to the AC Converter. These ac input voltages are then converted to dc voltages so that a full scale ac voltage input on any range will produce an AC Converter output to the A/D Converter of two volts dc.

3-10. When measuring an unknown resistance, the INPUT HI and LO terminals must be connected to the respective SOURCE HI and LO terminals. The shorting links provided on the front panel make the connection for two-terminal ohms measurements and the input leads attached to the terminals make the connection during four-terminal ohms measurements.

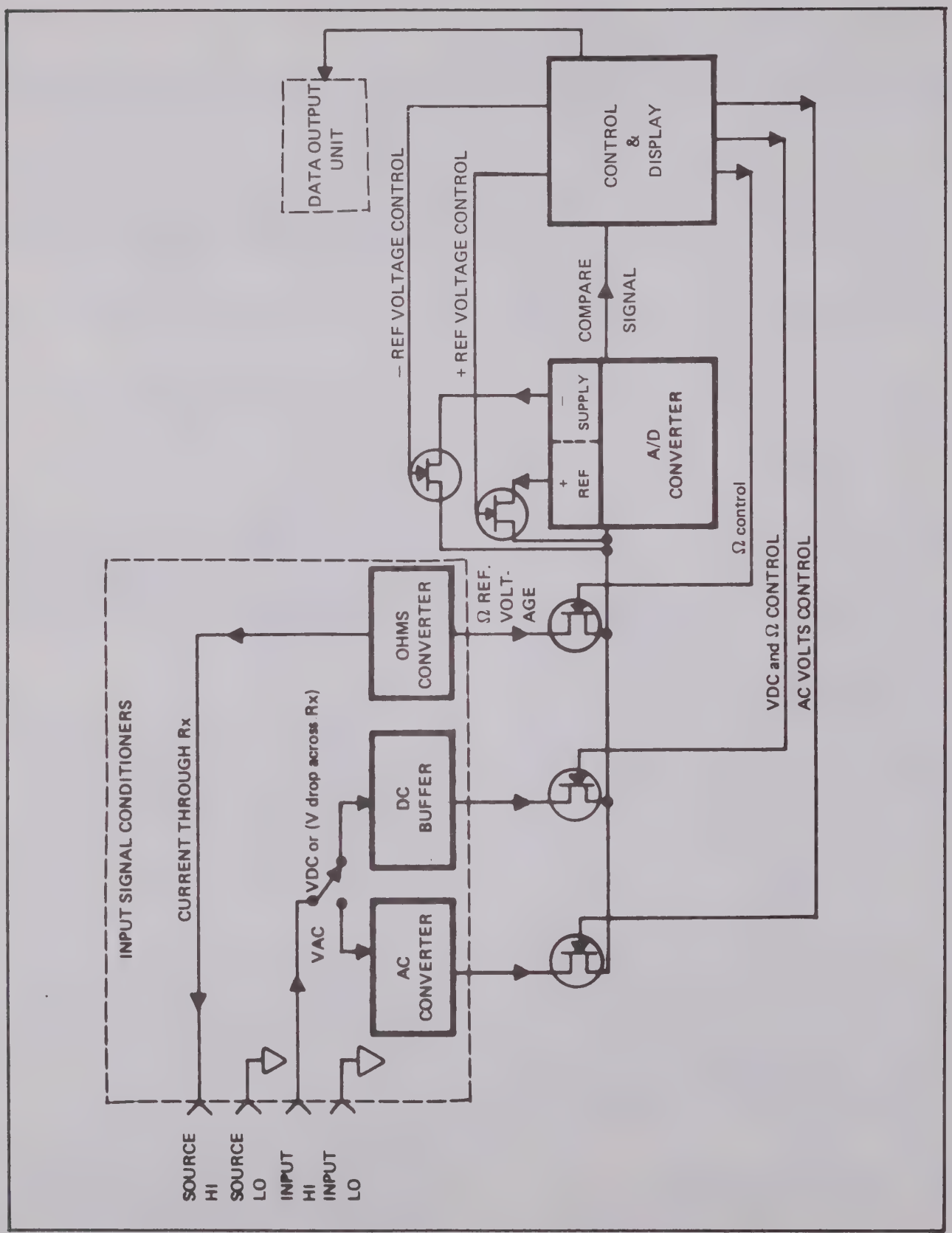


Figure 3-1. OVERALL FUNCTIONAL BLOCK DIAGRAM

3-11. The unknown resistance (RX) is supplied with current from the Ohms Converter while the voltage drop across RX, caused by the current, is applied to the VDC Buffer as a representation of the unknown resistance. The Ohms Converter also applies the same current through a known resistance value to develop a reference voltage used in the A/D Converter in the KΩ function.

3-12. A/D Converter

3-13. A dual slope intergration technique is used in the 8800A. The A/D Converter receives the dc voltage output from one of the Input Signal Conditioners and integrates it for 100 mS. Figure 3-2 is an illustration of the output of the A/D integrator. The slope of the integrator output voltage during the Integrate Period is proportional to the input applied to the instrument. At the end of the integrate period the signal conditioner dc voltage is disconnected from the A/D input and a dc reference voltage, of opposite polarity, is connected to the input(start of the read period). The A/D Converter then integrates the reference voltage so that the slope of the Read Period is always constant. Since the read period slope is held constant the time required for the A/D integrator output voltage to return to the zero detect point is then proportional to the instrument input.

3-14. The digital representation of the input is obtained by counting the number of cycles of a clock oscillator frequency that occur from the start of the read period to the point where the A/D integrator output voltage returns to the zero detect level. The A/D Converter supplies the Control and Display section with a compare signal at the end of the read period. The compare signal stops the counting of the clock oscillator pulses so that the analog value of the instrument input is now digitally represented by the number of oscillator pulses counted.

3-15. Control and Display

3-16. The Control and Display section provides the peoperly timed signals that direct the output of the correct Input Signal Conditioner to the A/D Converter during the integrate period. At the end of integrate time period the Control and Display section connects the appropriate reference supply to the A/D Converter input for the read period. The output of the 1 MHz oscillator is used to maintain the proper timing of the control signals.

3-17. The clock oscillator pulse count, accumulated during the read period, is applied to the LED display to produce the digital readout of the instrument input signal. The range information for the selected range, position the decimal point and illuminates the proper display annunciator.

3-18. Data Output Unit (DOU)

3-19. The DOU provides the display data as a rear panel card-edge output. The bcd information presented to the instrument display (polarity, overload, range code, and digit) is also applied to the DOU input. A busy flag is provided to indicate that the output data is invalid while the 8800A is taking a new input measurement. A register pulse train plus one of the data strobe signals time the data transfer to ensure that the data supplied to the DOU output is stable and not taken during the transition periods between individual digit information.

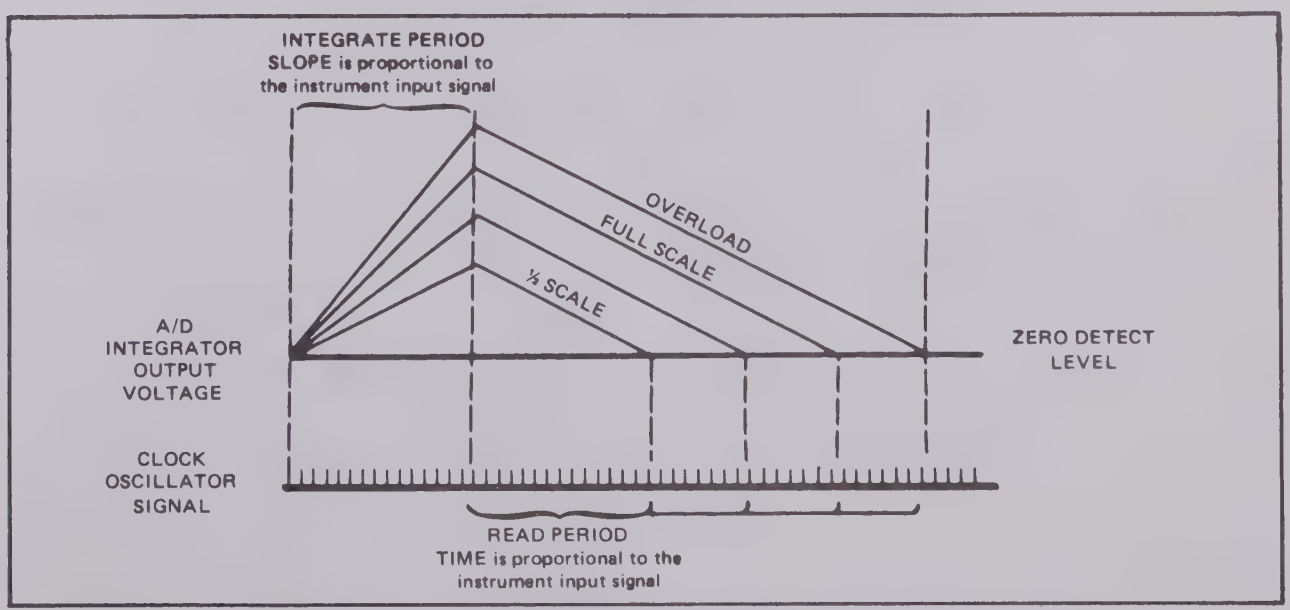


Figure 3-2. TIMING DIAGRAM FOR DUAL-SLOPE A/D CONVERSION

3-20. CIRCUIT DESCRIPTION

3-21. The following paragraphs provide an analysis of the functional areas of the 8800A at a simplified circuit level. The simplified circuits described in these paragraphs correspond to the associated detailed schematic diagrams included at the end of this manual.

3-22. Component reference designators mentioned in the text identify the component on the simplified circuit drawings and on the schematic diagrams. The reference designators for integrated circuits containing two or more gates or functions are presented in text with a numeric suffix. This suffix corresponds to an integrated circuit pin of the particular gate or function. For example, the reference designator U11-6 identifies integrated circuit number 11 and the specific gate or function associated with pin six.

3-23. Input Signal Conditioners

3-24. AC CONVERTER

3-25. The AC Converter produces a dc output voltage proportional to the ac input voltage. The simplified circuit diagram of the AC Converter, presented in Figure 3-3, should be refered to when reading the following description of the circuit operation.

3-26. The ac voltage input is capacitively coupled across C1 through input impedance resistor R1 to the inverting input of amplifier Q1, U1. The gain of the amplifier is determined by the ratio of the feed-back resistance, as selected by range relays K6, K7 and K8, to the input resistor R1. The amount of alternating current at the junction point of CR4 and CR5 is therefore proportional to the level of the ac voltage input. One-half of the alternating current passes through CR5 to develop a dc voltage level at the input of Low Pass (L.P.) Filter. The L.P. Filter then filters the ac signal superimposed on the dc voltage to produce a dc output voltage directly proportional to the ac voltage input.

3-27. The AC Converter circuitry creates an offset voltage that, if not compensated for, would create an error in the displayed value of the ac input voltage. The offset voltage, sensed at the junction point of R17, C13, and C14, is applied to C18 when FET switches Q6 and Q9 are turned on; these switches are turned off by an integrate (INT) signal applied

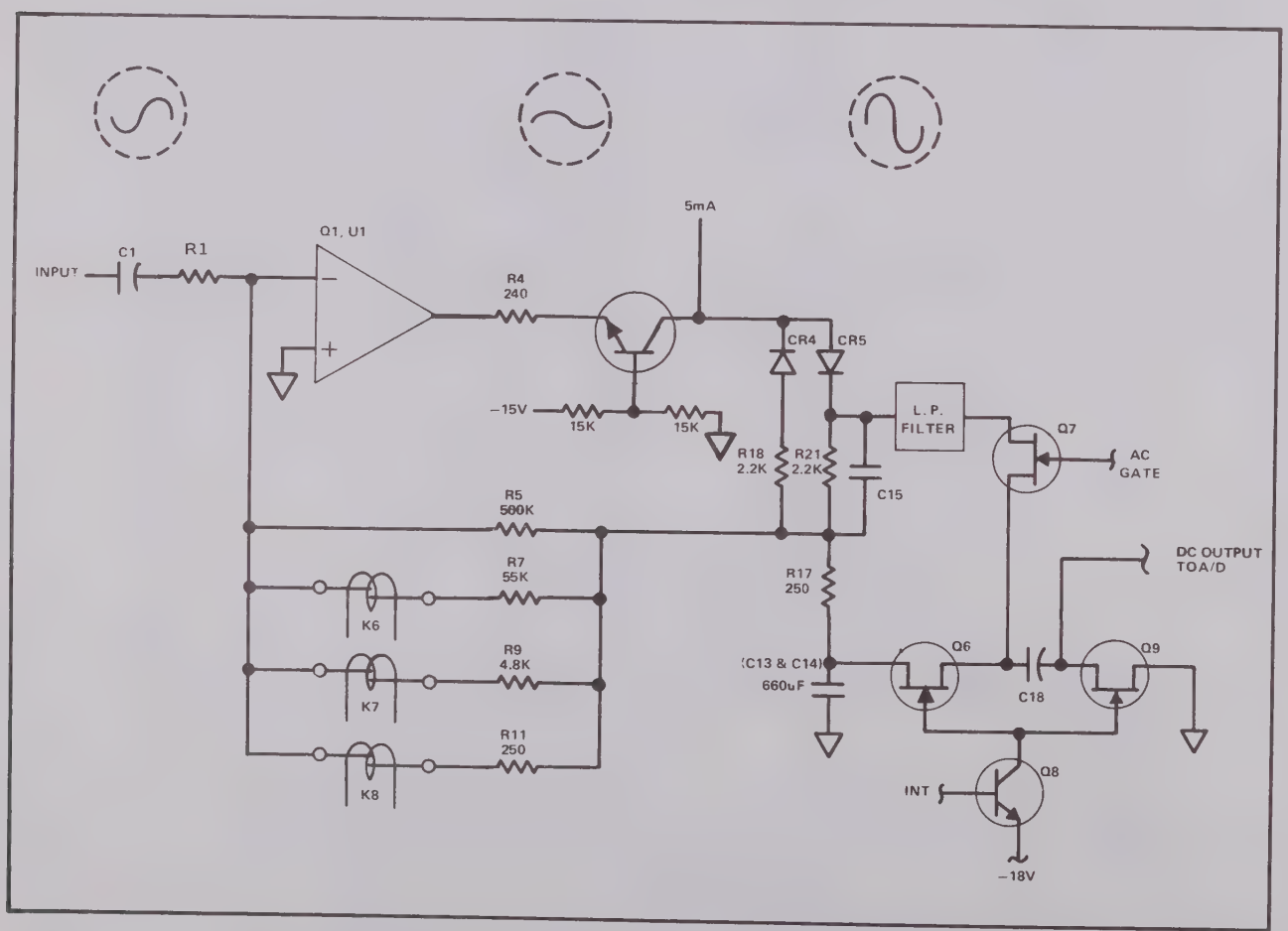


Figure 3-3. AC CONVERTER SIMPLIFIED CIRCUIT DIAGRAM

to Q8. When the AC GATE command (coincidental with the INT command) turns on Q7, the dc output voltage of the L.P. Filter will be reduced by the value of the feed-back voltage store in C18. The dc voltage output to the A/D Converter is therefore representative of the level of ac voltage input.

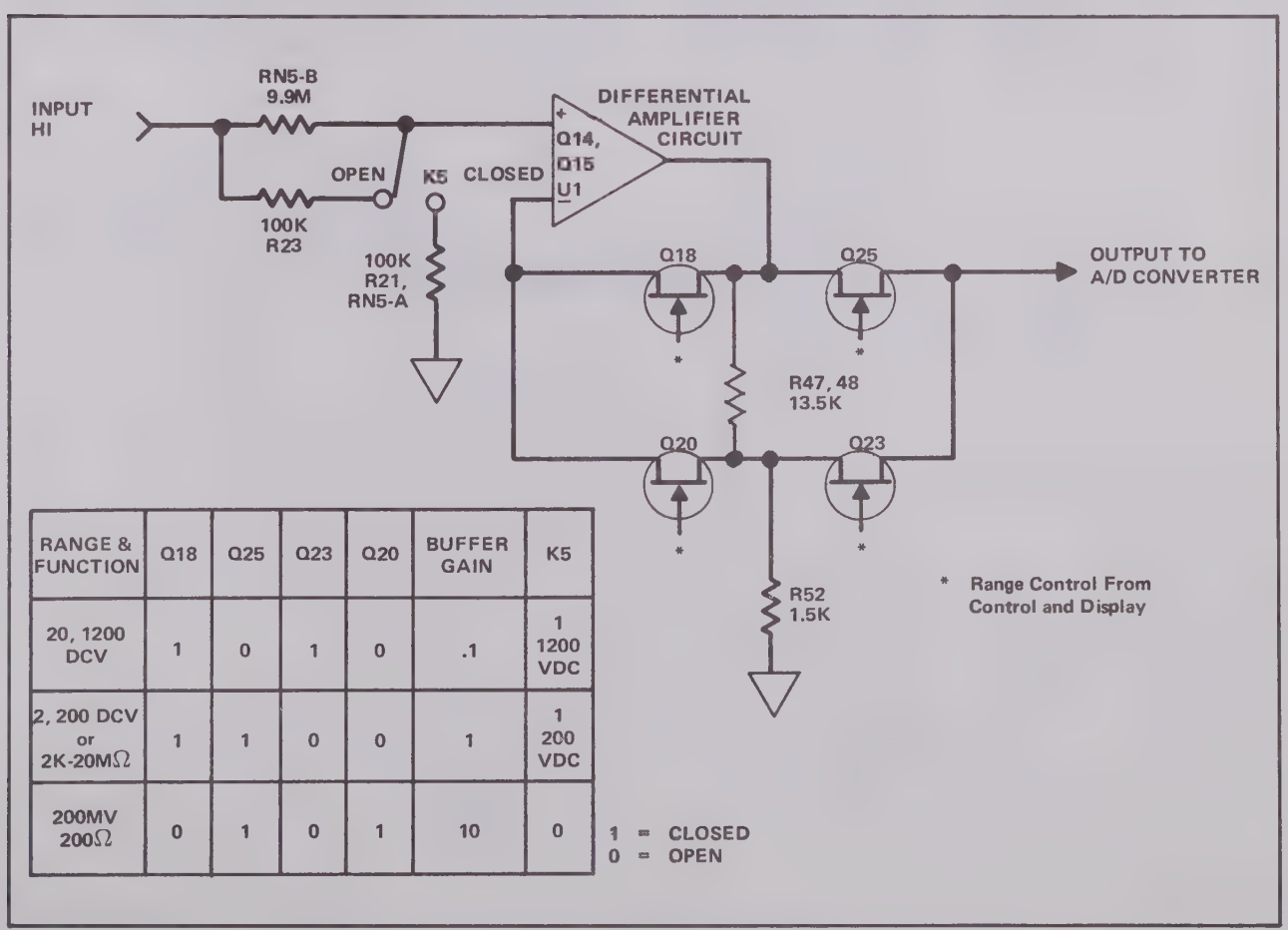
3-28. DC BUFFER

3-29. DC voltage inputs applied to the instrument are conditioned by the DC Buffer so that an input within any dc voltage range chosen produces a buffer output of two volts dc or less. The simplified buffer circuit shown in Figure 3-4 will be used to illustrate how the overall gain of the buffer is changed with range selection in order to maintain the required output. The ohms function also uses the DC Buffer when determining the value of an unknown resistance. As indicated by the table in Figure 3-4 the buffer gain is 1 (unity) for the 2K thru 20MΩ ranges and 10 for the 200Ω range.

3-30. When the 200 mV or 200Ω range is selected FET switches Q25 and Q20 close. This configuration produces a differential amplifier circuit gain of ten by returning only one-tenth of the amplifier output back to the inverting input. The DC Buffer output through Q25 to the A/D Converter will be two volts for a full scale input of 200mV or 200Ω.

3-31. A differential amplifier circuit gain of one is obtained when the 2 or 200 DCV range, or 2k thru 20MΩ range is selected. Range control signals from the Control and Display circuits close switches Q18 and Q25. Direct feedback through Q18 causes the differential amplifier to operate at unity gain. This amplifier circuit configuration produces the required two volt output to the A/D Converter representing a full scale instrument input. Selecting the 200 volt range in the DCV function, in addition to configuring the differential amplifier circuit for unity gain, closes relay K5 to provide a 100:1 voltage divider (RN5-B, R21, and RN5-A) to reduce a full scale 200 volt instrument input to two volts at the amplifier input.

3-32. Switches Q18 and Q23 close when either the 20 volt or 1200 volt range is selected. Selecting the 1200 volt range



RANGE & FUNCTION	Q18	Q25	Q23	Q20	BUFFER GAIN	K5
20, 1200 DCV	1	0	1	0	.1	1 1200 VDC
2, 200 DCV or 2K-20MΩ	1	1	0	0	1	1 200 VDC
200MV 200Ω	0	1	0	1	10	0

1 = CLOSED
0 = OPEN

Figure 3-4. VDC BUFFER SIMPLIFIED CIRCUIT DIAGRAM

also causes relay K5 to close, again creating a 100:1 voltage divider across RN5-B, R21, and RN5-A. This voltage divider reduces the high instrument input voltages (1200 volts maximum) to 12 volts or less at the differential amplifier circuit input. The output of the differential amplifier circuit is applied to a 10:1 voltage divider consisting of R47, R48, and R52. The differential amplifier circuit, operating at unity gain when Q18 is closed, applies up to 20 volts in the 20 DCV range and 12 volts in the 1200 DCV range to the voltage divider. The voltage divider is tapped, through Q23, to provide one-tenth of the amplifier output to the A/D Converter.

3-33. OHMS CONVERTER

3-34. The Ohms Converter determines the value of an unknown resistance by comparison. When the same current is applied to a resistance of known value and a resistance of unknown value the voltage level developed across each is directly proportional to the value of each resistance. A comparison of the two voltage levels will indicate the value of the unknown resistance relative to the value of the known resistance. The simplified circuit diagram, in Figure 3-5 shows how the Ohms Converter produces the two voltages to be compared by the A/D Converter.

3-35 The current to be applied to the known and unknown resistance is supplied by a constant current source consisting of a voltage regulator, (Q21, and Q1), and a current regulator, (Q2, and CR2).
The voltage regulator is designed such that any change in input or output voltages will proportionally change Q2's impedence thus drawing the output voltage back to the desired value. This output voltage controls the bias on Q2's base, and with a constant emitter bias, (supplied by CR12) Q2's collector current will remain very stable over wide variances in supply voltage or load conditions. This current is then applied to the known and unknown values of resistance so that a comparison can be obtained.

3-36. The ohms converter also employs an overvoltage protection circuit consisting of Q2, Q22, and Q23, such that it can withstand up to 1Kv dc or RMS inadvertently being connected to the ohms converter input leads. The high voltage applied to the protection circuit in such a case is enough to make appreciable reverse current to flow through Q23. This will effectivily connect Q23 and Q22 in series, since each transistor has a standoff of 350V the total is now 700V. If the voltage continues to rise Q2 will also be in series and the total standoff will then be greater than 1Kv. The current in this case is dissipated by resistors R35, R36, and R37.

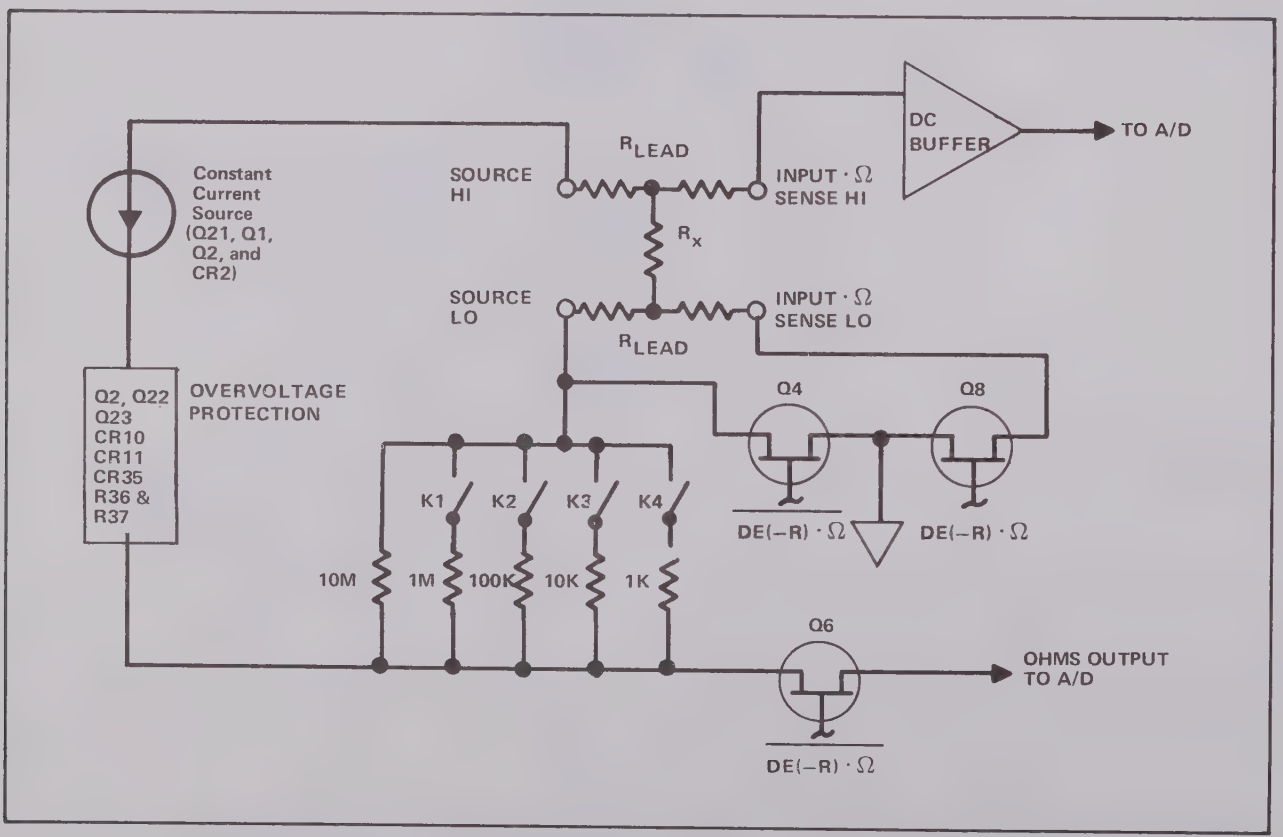


Figure 3-5. OHMS CONVERTER SIMPLIFIED CIRCUIT DIAGRAM

CAUTION!

It should be noted that the protection scheme used in the ohms converter is designed primarily for protection of voltages below 250V dc & ac, but can withstand transients of up to 1Kv.

3-37. During the integrate time period (see Figure 3-2) the DE(–R) · Ω control signal closes switch Q8. The positive voltage developed by the current flow across R_X is applied through the INPUT · Ω SENSE HI terminal to the DC Buffer and A/D Converter. At the end of the integrate period Q8 opens and Q4 and Q6 close. The negative voltage developed across the known resistance, termed ohms output, passes through Q6 to the A/D Converter.

3-38. A/D Converter

3-39. The A/D Converter uses a dual-slope conversion technique. The dc voltage input to the A/D Converter, representing an unknown value of instrument input, is integrated (charges a capacitor) for a controlled length of time (100ms). The level to which the capacitor is charged is directly proportional to the level of the dc voltage at the input. The capacitor is then discharged at a controlled rate so that the discharge time is proportional to the level of charge on the capacitor. A digital representation of the discharge time is obtained by counting the number of cycles of a reference frequency that occur from the start of discharge to the point where the capacitor charge reaches a selected zero detect level. Figure 3-6 is a basic illustration of the A/D Converter circuit.

3-40. The input to the A/D Converter is selected from one of the three input signal conditioners. The selected input is applied to U3, a unity gain input buffer, during the integrate time period. The buffer output passes across Q39 to an integrator the output of which is determined by the level of input applied. The integrator output charges capacitor C9 at a rate determined by the input so that at the end of the 100 ms integrate time period the charge on the capacitor is directly proportional to the input applied. At the end of the integrate time period the integrator is isolated from the buffer when control signal △ 2 opens Q39 for 1ms. This allows the input to U3 to be changed from the dc voltage representing the unknown input to the appropriate reference input without affecting the charge stored on C9.

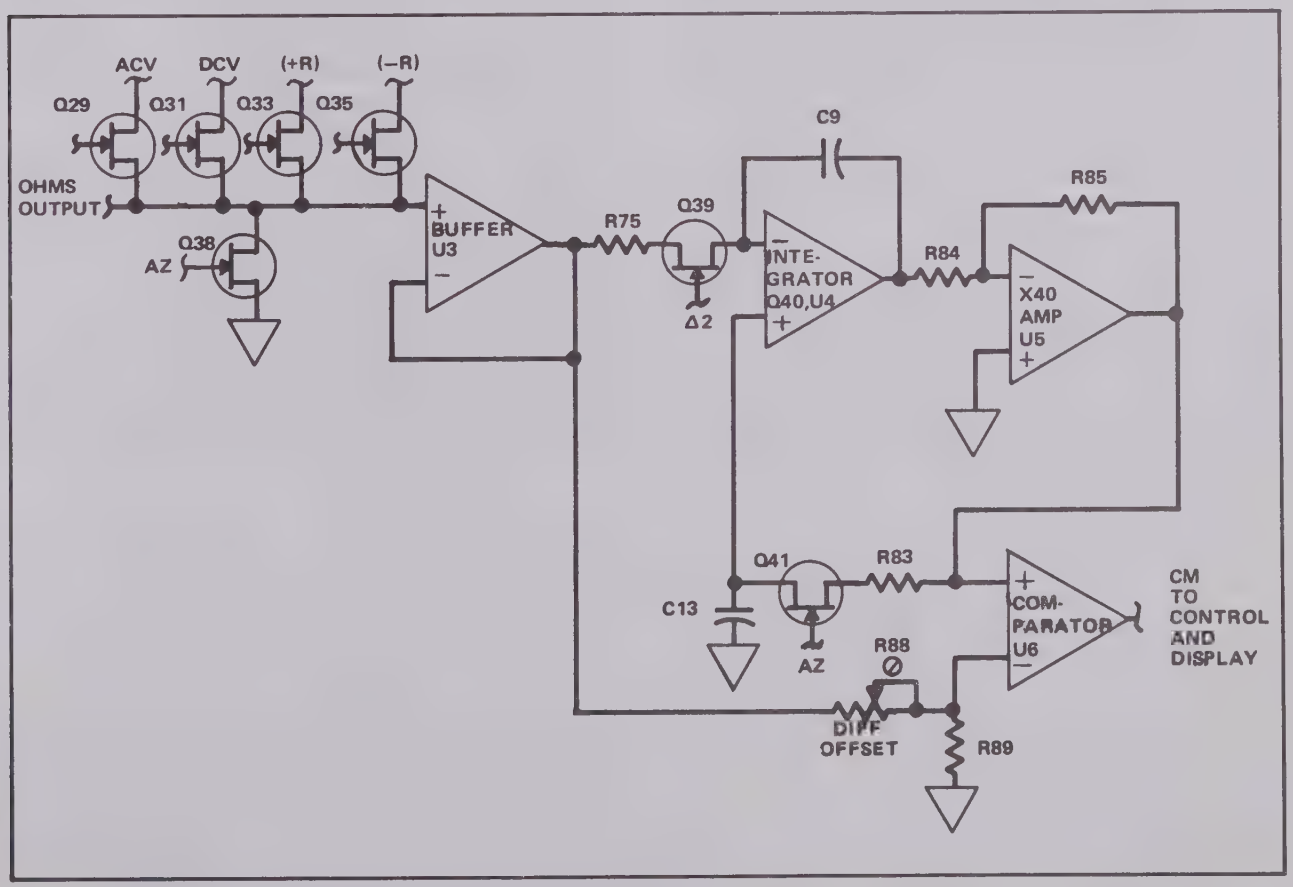


Figure 3-6. A/D CONVERTER SIMPLIFIED CIRCUIT DIAGRAM

3-41. The reference voltage passes through U3 and Q39 to the input of the integrator. Because the polarity of the reference voltage is opposite that of the unknown; the integrator starts to discharge capacitor C9. The rate of discharge is determined by the value of the reference voltage. The charge on C9 is applied to the input of amplifier U5. The amplified output is applied to one input of comparator U6. A dc voltage level, determined by the differential offset adjustment R88, is connected to the other comparator input. When the decreasing charge on C9 reaches the same level as that provided by the differential offset adjust, U6 will produce a compare (CM) output signal to stop the digital count in the Control and Display circuit.

3-42. Control and Display

3-43. The discussion of the Control and Dispaly circuit operation that follows is referenced to the schematic diagrams in Figures 8-2 and 8-3. These schematics are located in Section 8 of this manual. Operation in the VAC FUNCTION will be used as an example of circuit operation.

3-44. Selecting the VAC FUNCTION switch S2 (see Figure 8-2) provides the AC control command output at J2 pin 2 and connects the INPUT HI terminal to the AC Converter input. The AC signal is applied to NAND gates in U15 (see Figure 8-1, Sheet 2) and to switch U20 where it selects the ST2 signal output for P2 pin 14. With the proper gates enabled by the AC command the outputs from U11, derived from the 1 MHz oscillator signal, provide timing commands to control the multimeter circuits during the ac volts measurement.

3-45. The measurement cycle starts with the INT signal output at U11 pin 40. This signal is inverted by U15-5 to produce the INT command which, when combined with the AC command at U15-9, results in the INT · AC signal used to gate the AC Converter output into the A/D Converter during the integrate time period. As the INT signal U11-40 goes high, indicating the end of the 100ms integrate time period, the 2 signal at U11-3 goes high for 1ms while the input to the A/D Converter is switched from the unknown to the reference voltage. The reference supply signal comes from U11-39, DE(−R). This signal is inverted by U13-14 and applied to U14-3. Since U14 pin 5 is held high, unless the KΩ function is called, the DE(−R) · Ω command will gate the negative one volt reference to the A/D Converter input for the read time period.

3-46. At the end of the△2 signal decade counters within U11 start to count the cycles of the 1 MHz oscillator input at U11 pin 6. The count accumulation continues until a compare (CM) signal from the A/D Converter is received at U11 pin 5. The total in each decade counter is converted to a bcd format, identified as signals W, X, Y, and Z with corresponding bit weights of 8, 4, 2, and 1. The digit information is strobed out to the display from pins 34, 33, 32, and 31 of U11 one significant digit at a time.

3-47. Eight strobe signals numbered ST0 through ST7, are created within U11 to properly time the transfer of data from U11 to the display. Six strobe signals (ST0, ST1, ST2, ST3, ST4, and ST6) are used to transfer digit information and the remaining two (ST5 and ST7) transfer range, polarity and overload data. The most significant digit of the display is the first to be strobed out of U11. Strobe signal ST7 from U11-22 passes through switch U20 pin 12 to 14 (DCV function causes the switch to shift to pin 13) to the display strobe drivers Q44 and Q45. The DS1 output signal on P1-3 is applied to pins 1 and 14 of the most significant digit LED (DS1), enabling only that LED to display the incoming digit information. The same ST7 strobe signal is used within U11 to cause the bcd information for the most significant digit to be applied, via U11 pins 34, 33, 32, and 31, to the seven segment decoder U16. The bcd code input causes the decoder to illuminate segments of the LED to display the corresponding number. Each LED is individually strobed to display the corresponding significant digit output from U11.

Section 4
Maintenance

WARNING!

THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

4-1. INTRODUCTION

4-2. This section of the manual contains information concerning maintenance and servicing of the Model 8800A Digital Multimeter. A calibration interval of 90 days is recommended to insure instrument operation within the 90-day specifications. Test equipment recommended for performance tests, calibration adjustments and troubleshooting is listed in Table 4-1. If the recommended equipment is not available, equipment of equivalent specifications may be used.

Table 4-1. REQUIRED TEST EQUIPMENT

NOMENCLATURE	MINIMUM SPECIFICATIONS	RECOMMENDED EQUIPMENT
AC Calibrator	Voltage Range: 0 to 1000V ac Frequency Range: 50 Hz to 100 kHz Voltage Accuracy: 50 Hz to 20 kHz 0.03% 20 kHz to 100 kHz 0.05%	John Fluke Model 5200A and 5205A
DC Calibrator	Voltage Range: 0 to 1000V dc Accuracy: 0.003%	John Fluke Model 332B
Voltage Divider	Ratio Range: 0 to 1.0 Absolute Linearity: ±1 ppm of input at dial setting	John Fluke Model 720A
Resistor Decade	Resistance Accuracy: 0.005%	ESI 1063B
Frequency Counter	Range: 2 MHz Resolution: 100 Hz	John Fluke Model 1941A
Oscilloscope	General Purpose with 10MΩ Probe	Tektronics Model 453
Digital Multimeter	Voltage Accuracy: 0.1% Input Impedance: 10MΩ	*John Fluke Model 8000A

* If the selectable offset voltage correction resistor procedures are performed a DVM with a 1μV resolution is required; recommend a John Fluke 8400A or 8800A.

4-3. SERVICE INFORMATION

4-4. Each instrument manufactured by the John Fluke Mfg. Co., Inc. is warranted for a period of one year upon delivery to the original purchaser. The WARRATNY is printed on the back of the title page located at the front of the manual.

4-5. Factory authorized calibration and service for each Fluke product is available at various world wide locations. A complete list of these service centers is included with the WARRANTY. Shipping information is given in Section 2 of this manual. If requested an estimate will be provided to the customer before any repair work is begun on instruments that are beyond the warranty period.

4-6. GENERAL MAINTENANCE

4-7. Access/Disassembly

4-8. The following procedure is used to gain access to the interior of the 8800A.

a. Remove the line power cord from the unit.

b. Remove the molded plastic outer cover; two screws at the rear of the unit hold it in place. This provides access to the calibration adjustment.

c. Remove the top and bottom guard covers; slide the covers one-half the distance to the rear of this unit, then lift straight up to remove. This allows access to the components on the various printed circuit boards.

CAUTION!

The area on the Display PCB Assembly where the input terminals extend through, must not be contaminated in any way. The inter terminal leakage caused by contamination will result in calibration errors.

d. Remove the AC Converter PCB or Ohms Converter PCB by disconnecting the associated wires and pulling the pcb straight away from the Main PCB.

NOTE!

When reinstalling the AC Converter and Ohms Converter PCB's, insure that all connector pins are properly aligned before seating the board.

4-9. Cleaning

4-10. Clean the instrument periodically to remove dust, grease and other contamination. Use the following procedure:

a. Clean the front panel and exterior surfaces with anhydrous ethyl alcohol or a soft cloth dampened with a mild solution of detergent and water.

b. If cleaning of the inerior is necessary use clean, dry air at low pressure (20 psi). If contaminants remain individual pcbs can be cleaned using warm water, however; any items likely to be affected by the water (batteries, meters, etc.) should be removed first. Excess water should be blown free with the clean dry air followed by a thorough drying. Do not use drying temperatures in excess of 50°C. If any solvent is used, such as freon, it should be kept clear of any switches or potentiometers since it removes lubrication and shortens the life span dramatically.

4-11. Fuse Replacement

WARNING!

Line power voltage is present at the fuse holder whenever the power cord is connected. Remove the power cord before servicing the fuse.

4-12. The power fuse (F1) is located in the right rear corner of the instrument, and can be reached by performing the access and disassembly procedure. If replacement is necessary, use an AGC ¼ ampere fuse for either 115V ac or 230V ac power configuration.

4-13. LED Replacement

4-14. The following procedure is used to replace the Display or indicator LEDs.

a. Perform steps a, b and c of the Access/Disassembly instructions, paragraph 4-8.

b. Remove the four side screws connecting the Front Panel to the side chassis. Lift the Front Panel away from the main portion of the instrument.

c. Disconnect, at the main pcb dip sockets, the two flat cables connecting the Front Panel.

d. Disconnect the wires from the connector posts on the display pcb.

e. Remove the binding post nuts and the two phillips screws and lift the display pcb away from the Front Panel.

f. Unsolder the defective display or indicator LED and replace.

g. Reassemble in the opposite order, insuring the switch pushbutton connects between the crossbar and the lower retaining ring on the switch plunger. An illustration of the switch assembly is shown in the Parts List, Figure 5-3.

4-15. Component Modifications

4-16. On versions of the Main PCB etched with the part number 8800A-3001, Rev. A through Rev. J, U5 is drilled to accept an eight lead dual in-line IC. However, the preferred replacement is the round TO-5 metal package. To fit the round TO package into the rectangular pattern bend the legs into the correct position with a pair of long nosed pliers and insert the legs into the drilled holes, remembering that the TO package is keyed on pin 8 while the drill pattern is keyed with the square marked hole at position1.

4-17. Due to expansions of the DVM's capabilities additional parts may be necessary when replacing U11. If diode CR39 is installed on pin 10 of U11 (See Figure 8-1), no additional parts or installation procedure is required, and part #354985 will be used for ordering. However if diode CR39 is not installed on pin 10 of U11 a kit containing additional parts and installation procedures are required and part #407734 will be used in ordering to obtain these.

4-18. PERFORMANCE TESTS

4-19. Introduction

4-20. The following tests are intended for use in performance testing of the 8800A. The tests compare the instrument performance to the accuracy specifications and are especially suited to acceptance testing of new instruments. Tests should be conducted under the following conditions: ambient temperature 25°C ±5°C, relative humidity less than 70%.

NOTE!

Tolerances and test limits for performance tests are derived from the 90-day instrument specifications.

4-21. Should the 8800A fail this performance test, corrective maintenance or calibration will be required. The troubleshooting information given later in this section will help analyze and isolate the problem. The 8800A performance test will evaluate each of the three multimeter functions using the procedure provided in the following paragraphs. Use the test equipment recommended in Table 4-1.

4-22. DC Volts Verification

4-23. Using the dc calibrator and voltage divider apply the voltages indicated in Table 4-2 to the 8800A input terminals. Select the ranges prescribed and observe the 8800A display for the proper results.

NOTE!

Use 720A with calibrator for all voltages below 2.0v.

NOTE!

Before starting this procedure, place a good quality shorting link across the INPUT - Ω SENSE terminals HI to LO and adjust the front panel DC ZERO for a display of exactly zero.

Table 4-2. DC VOLTAGE VERIFICATION

RANGE	INPUT	DISPLAY READING	LED INDICATION
2 VDC	Shorted	–.00001 – +.00001	
	+1.00000	+.99987 – +1.00013	
	–1.00000	–1.00013 – –.99987	
	+1.90000	+1.89978 – +1.90022	
	–1.90000	–1.90022 – –1.89978	
20 VDC	+19.0000	+18.9978 – +19.0022	
	–19.0000	–19.0022 – –18.9978	
200 VDC	+190.000	+189.978 – +190.022	
	–190.000	–190.022 – –189.978	
1200 VDC	+1000.00	+999.87 – +1000.13	
	–1000.00	–1000.13 – –999.87	
200 mV	+.10000	+99.980 – +100.020	200m VDC
	–.10000	–100.020 – –99.980	200m VDC
AUTO	+.10000	+99.980 – +100.020	200m VDC
	+1.00000	+.99987 – +1.00013	
	+10.0000	+9.9987 – +10.0013	
	+100.000	+99.987 – +100.013	
	+1000.00	+999.87 – +1000.13	

4-24. Auto Ranging Verification

4-25. Verify that the Auto Ranging circuitry changes ranges at the proper voltage points using the following procedure:

a. Insure the dc calibrator and voltage divider are connected for an input to the 8800A.

b. Select AUTO on the front panel.

c. Apply +200mV to the 8800A.

d. Display reads +.19995 to +.20005.

e. Decrease the applied voltage to 183 mV. Display reads +.18295 to +.18305.

f. Decrease the applied voltage in 1 millivolt steps until the 8800A autoranges. The 200 mV - 200Ω LED indicator comes on and the applied voltage is between 177.5 and 182.5 millivolts. The display should read the applied voltage in millivolts ±.19 millivolts.

g. Slowly increase the applied voltage until the 8800A autoranges to the 2 volt range. The 200 mV - 200Ω LED indicator is extinguished, the decimal point on the display moves two positions to the left and the applied voltage is approximately, but greater than 190 millivolts.

4-26. AC Volts Verification

4-27. Using the ac calibrator, apply the voltages indicated in Table 4-3, to the 8800A input terminals. Select the range and observe the 8800A display for the proper results.

Table 4-3. AC VOLTAGE VERIFICATION

RANGE	VOLTAGE	FREQUENCY	DISPLAY READING
2 VAC	1.00000	400 Hz	.99890 – 1.00110
2 VAC	1.0000	100 kHz	.98940 – 1.01060
20 VAC	10.0000	400 Hz	9.9890 – 10.0110
20 VAC	10.0000	100 kHz	9.8940 – 10.1060
200 VAC	50.000	400 Hz	49.940 – 50.060
200 VAC	50.000	100 kHz	49.440 – 50.560
1200 VAC	100.000	400 Hz	99.730 – 100.270
1200 VAC	100.000	20 kHz	99.510 – 100.490
AUTO	.100000	10 kHz	.09980 – .10020
AUTO	1.00000	10 kHz	.99890 – 1.00110
AUTO	10.0000	10 kHz	9.9890 – 10.0110
AUTO	100.000	10 kHz	99.890 – 100.110
AUTO	1000.00	10 kHz	996.88 – 1003.12

4-28. Ohms Verification

4-29. Using the resistor decade, apply the resistance values indicated in Table 4-4, to the 8800A input terminals. Select the range and observe the 8800A display for the proper results.

NOTE!

Use four-terminal ohms measurement method.

Table 4-4. OHMS VERIFICATION

RANGE	INPUT	DISPLAY READING	LED INDICATION
20MΩ	10MΩ	9.9797 – 10.0203	20MΩ
2000KΩ	1000KΩ (1MΩ)	999.47 – 1000.53	
200KΩ	100KΩ	99.987 – 100.013	
20KΩ	10KΩ	9.9987 – 10.0013	
2KΩ	1KΩ	.99987 – 1.00013	
200Ω	100Ω	99.970 – 100.030	200Ω
200Ω	10Ω	09.988 – 010.012	200Ω
AUTO	10Ω	09.988 – 010.012	200Ω
AUTO	100Ω	99.970 – 100.030	200Ω
AUTO	1KΩ	.99987 – 1.00013	
AUTO	10KΩ	9.9987 – 10.0013	
AUTO	100KΩ	99.9987 – 100.013	
AUTO	1000KΩ (1MΩ)	999.47 – 1000.53	
AUTO	10MΩ	9.9797 – 10.0203	20MΩ

4-30. CALIBRATION

4-31. Introduction

4-32. The Model 8800A should be calibrated every 90 days or when ever repairs have been made, in order to maintain the instrument within its rated accuracy. The calibration procedure should be performed under the following environmental conditions: Ambient temperature of 23°C ± 1°C, relative humidity less than 80%. Refer to Table 4-1 for the recommended test equipment. Calibration adjustments are identified on the top inner guard cover. Perform the following preliminary steps before calibrating the instrument.

a. Remove the molded plastic outer cover.

b. Leave the top and bottom inner guard covers in place.

c. Connect the 8800A to the appropriate (115V ac or 230V ac) line power.

d. Turn the instrument on and allow it to warm-up for a minimum of one-half hour.

e. Insure that the ac and dc calibrators are up to their respective operating temperatures.

4-33. Pre-Calibration Procedure

NOTE!

Use the 720A with the 332B DC Calibrator to source all voltages below 2 volts.

4-34. The transistors Q14 and Q15, the U1 Op Amp, and the selectable resistors R34 and R38 are a matched set installed at the factory. If any one of the five are changed due to calibration requirements or failure the selectable Offset Voltage Correction Resistor procedures outlined later in the calibration procedure paragraph must be performed.

4-35. ZERO ADJUST

a. Short the two INPUT terminals together.

b. Select the VDC function and 200 mV range.

c. Adjust the front panel DC ZERO adjust for an 8800A display of 00.000 ±1 digit.

4-36. BIAS ADJUST

a. Place a 1 megohm resistor and 0.1 μF cap. across the input terminals.

b. Adjust BIAS adjust (R30) for an 8800A display of 00.000 ±3 digits.

NOTE!

The bias adjustment may cause a change in the zero adjustment. Repeat the zero adjust and bias adjust until no further change in the zero adjustment occurs.

4-37. Final Calibration Procedure

4-38. DCV FINAL CAL

a. Select the 2V range; DCV function.

b. Alternately apply +1.0 mV and −1.0 mV to the input terminals and adjust the MASTER OFFSET (R78) for the same absolute number (s) in both polarities.

c. Apply +1 mV to the input terminals and adjust DIFF OFFSET (R88) for exactly +.00100 on the 8800A display.

NOTE!

Occasional flashing of +.00101 or +.00099 is acceptable.

d. Short the input terminals.

e. Select the 200 mV and rezero the instrument if necessary.

f. Remove the short. Verify steps a through c.

g. Select the 2V range.

h. Apply +1.00000V and adjust +1V CAL (R99) for an 8800A display of +1.00000 ±1 digit.

i. Increase the input to +1.90000V; Display must be within ±3 digits.

j. Repeat steps h and i using a negative input and adjust −1V CAL (R97).

k. Apply the inputs listed in Table 4-5 to the 8800A on the 2V range, DCV function and note that all display readings are within one digit of the applied voltage.

Table 4-5. DCV LINEARITY CHECK

INPUT	DISPLAY
± .00100 V	± .00100 ± 1 digit
± .01000 V	± .01000 ± 1 digit
± .10000 V	± .10000 ± 1 digit
± .20000 V	± .20000 ± 1 digit
± .30000 V	± .30000 ± 1 digit
± .40000 V	± .40000 ± 1 digit
± .50000 V	± .50000 ± 1 digit
± .60000 V	± .60000 ± 1 digit
± .70000 V	± .70000 ± 1 digit
± .80000 V	± .80000 ± 1 digit
± .90000 V	± .90000 ± 1 digit
±1.00000 V	±1.00000 ± 1 digit

l. Select the 20V range; DCV function

m. Apply +10.0000V and adjust the 10VDC adjustment (R47) for an 8800A display of +10.0000 ± 1 digit.

n. Apply +100.000 mV to the input terminals.

o. Select the 200 mV range and verify the 8800A display is within ± 4 digits.

p. Repeat step n with a −100.000 mV input.

q. Select the 200V range; DCV function.

r. Apply +100.000 V and adjust 100 VDC adjustment (R21) for an 8800A display of +100.000 ± 1 digit.

s. Select the 1200V range; DCV function.

t. Apply +1000.00V and verify the 8800A display is +1000.00 ± 3 digits.

4-39. AC CONVERTER FINAL CALIBRATION

4-40. The AC Converter calibration procedure is presented in Table 4-6. Insure that the ac calibrator used to supply the required voltages, is up to its prescribed operating temperature. Replace shorting link between Hi & LO input terminals. Depress the VAC function switch on the 8800A and proceed with the test.

4-41. OHMS CONVERTER FINAL CALIBRATION

NOTE

Remove the shorting links that connect the two HI terminals together and the two LO terminals together. Use the four-terminal measurement technique (as pictured in Figure 2-2) for this procedure.

a. Select the kΩ function.

b. Apply a 10 MΩ standard resistance (ESI 1063B resistor decade) to the input.

c. Select the 20 MΩ range.

d. Adjust the 10 MΩ cal (R5) for an 8800A display of 10.0000 ±3 digits.

e. Apply a 100 kΩ standard resistance to the input. The display should indicate 0.1000 ±1 digit.

f. Apply a 1 MΩ standard resistance to the input. The display should indicate 1.0000 ±4 digits.

g. Select the 2000 kΩ range and adjust the 1 MΩ cal (R6) for an 8800A display of 1000.00 ±1 digit.

h. Apply a 100 kΩ standard resistance to the input. The display should indicate 100.00 ±1 digit.

i. Select the 200 kΩ range.

j. Adjust the 100 kΩ cal (R8) for an 8800A display of 100.000 ±1 digit.

k. Apply a 10 kΩ standard resistance to the input. The display should indicate 10.000 ±1 digit.

l. Select the 20 kΩ range.

m. Adjust the 10 kΩ cal (R10) for an 8800A display of 10.000 ±1 digit.

n. Apply a 1 kΩ standard resistance to the input. The display should be 1.0000 ±1 digit.

o. Select the 2 kΩ range.

p. Adjust the 1 kΩcal (R13) for an 8800A display of 1.00000 ±1 digit.

q. Apply a 100Ω standard resistance to the input. The display should be .10000 ±1 digit.

s. Select the 200Ω range.

t. Verify that the 8800A display is 100.000 ±6 digits.

u. Select the AUTO pushbutton.

Table 4-6. ACV FINAL CAL.

STEP	RANGE	INPUT	FREQ	ADJUST	READING	TOLERANCE
1	1200V	500	500 Hz	R20 (500V/500 Hz)	500.00	± 3 digits
2	1200V	500	10 kHz	C2 (100V/50 kHz)	500.00	± 3 digits
3	1200V	1.0V	500 Hz	–	001.00	± 5 digits
4	2V	1.0V	500 Hz	R6 (1.0V/500 Hz)	1.00000	± 5 digits
5	2V	1.0V	50 Hz	–	1.00000	± 70 digits
6	2V	1.0V	50 kHz	C7 (1.0V/50 kHz)	1.00000	± 20 digits
7	2V	1.0V	20 kHz	–	1.00000	± 30 digits
8Repeat step 2					500.00	± 50 digits
9 Repeat step 6					1.00000	± 50 digits
10	2V	1.0V	100 kHz	–	1.00000	± 530 digits
11	2V	1.9V	10 kHz	–	1.90000	± 100 digits
12	2V	20 mV	500 Hz	–	.02000	± 5 digits
13	200V	100V	500 Hz	R10 (100V/500 Hz)	100.000	± 5 digits
14	200V	100V	50 kHz	C23 (500V/10 kHz)	100.000	± 50 digits
15	20V	10V	500 Hz	R8 (10V/500 Hz)	10.0000	± 5 digits
16	20V	10V	50 kHz	C9 (10V/50 kHz)	10.0000	± 50 digits
17	1200V	1000V	20 kHz	–	1000.00	± 250 digits

v. Apply a 100Ω standard resistance to the input, and verify that the unit autoranges to the 200Ω range.

w. Remove the 100Ω resistance and verify that the unit autoranges to the 20 MΩ range.

NOTE

Insure the shorting links used to connect the two HI terminals together and the LO terminals together are replaced when the Ohm Converter Final Calibration is completed.

4-42. Selectable Offset Voltage Correction Resistors Procedure

4-43. The following procedures must be performed anytime that Q14, Q15, U1, R34 or R35 are changed during the calibration procedure or troubleshooting. A digital voltmeter with at least 1 microvolt resolution, such as the Fluke 8400A or another 8800A, is required.

4-44. SET-UP:

a. Select the 1 VDC range on the test equipment DVM.

b. Connect the LO input to common and the high input to TP13 on the 8800A under test.

c. Mechanically center the Front Panel DC ZERO control.

d. Select the 200 mVDC range on the 8800A under test and short the input terminals.

e. Connect jumpers across the selected resistor positions A and B.

f. Maximum allowable reading on the test DVM is ±0.05000. Any reading greater is out of the range of the resistor selection tables and the multimeter must be repaired. Refer to the troubleshooting procedure or return the instrument to an authorized Fluke Service Center.

4-45. BIAS ADJUST:

a. Note the reading on the test equipment DVM.

b. Replace the short across the input terminals with a 1MΩ resistor in parallel with a 0.1ufd capacitor.

c. Adjust the BIAS ADJ control for the same reading as noted above, plus or minus five digits.

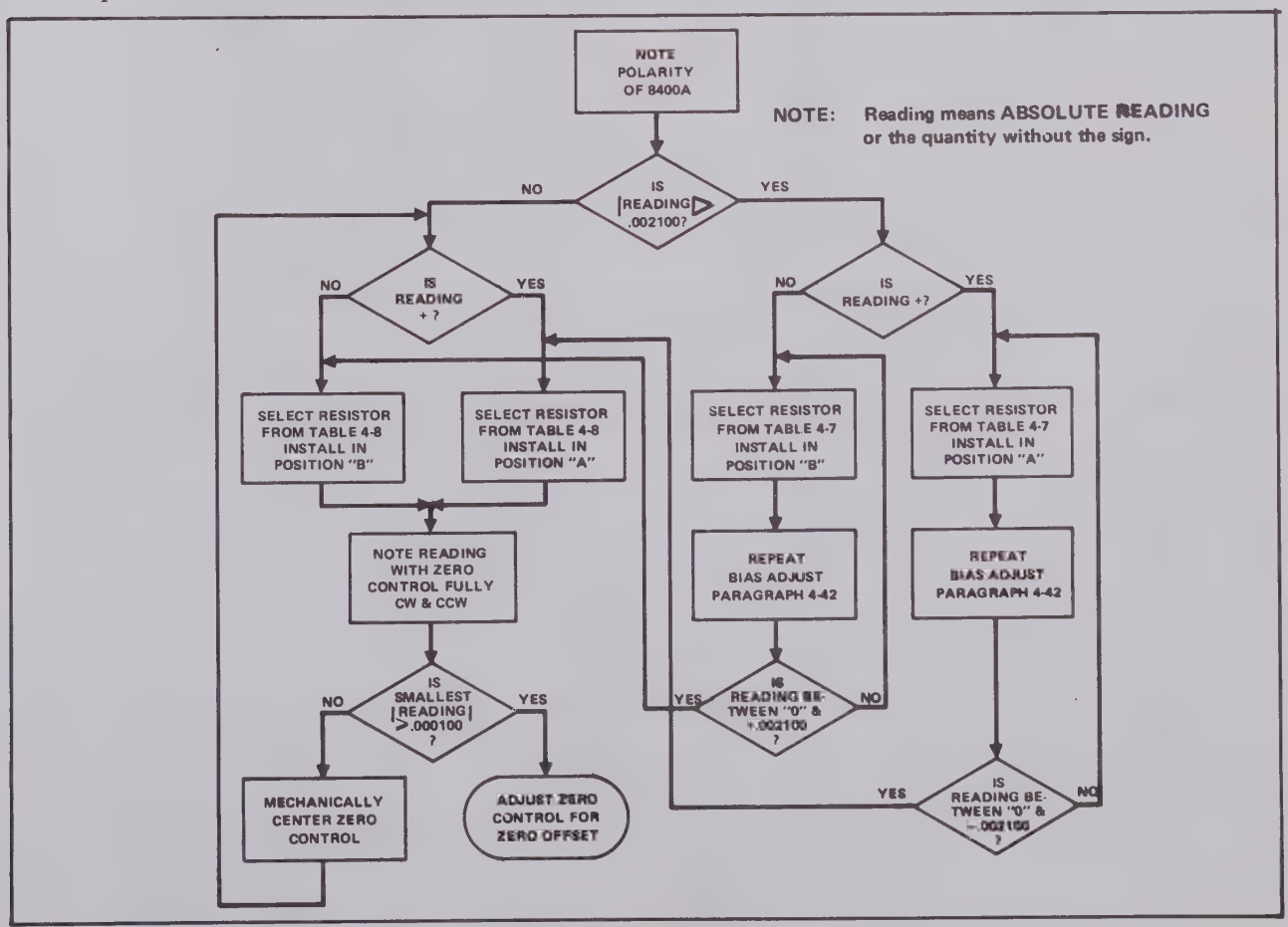

NOTE POLARITY OF 8400A
NOTE: Reading means ABSOLUTE READING or the quantity without the sign.
IS |READING| .002100?
NO
YES
IS READING + ?
IS READING +?
SELECT RESISTOR FROM TABLE 4-8 INSTALL IN POSITION "B"
SELECT RESISTOR FROM TABLE 4-8 INSTALL IN POSITION "A"
SELECT RESISTOR FROM TABLE 4-7 INSTALL IN POSITION "B"
SELECT RESISTOR FROM TABLE 4-7 INSTALL IN POSITION "A"
NOTE READING WITH ZERO CONTROL FULLY CW & CCW
REPEAT BIAS ADJUST PARAGRAPH 4-42
REPEAT BIAS ADJUST PARAGRAPH 4-42
IS SMALLEST |READING| >.000100 ?
IS READING BETWEEN "0" & +.002100 ?
IS READING BETWEEN "0" & −.002100 ?
MECHANICALLY CENTER ZERO CONTROL
ADJUST ZERO CONTROL FOR ZERO OFFSET

Figure 4-1. OFFSET RESISTOR SELECTION PROCEDURE

Table 4-7. OFFSET VOLTAGE CORRECTION RESISTORS (COARSE)

OFFSET VOLTAGE	COARSE RESISTOR	J.F. P/N	TOL. %	TEMPERATURE COEFFICIENT
0.00000 - 0.00200	None	------		
0.00201 - 0.00400	31.6k	261610	1%	T0
0.00401 - 0.00600	47.5k	289546	1%	T0
0.00601 - 0.00800	63.4k	235382	1%	T0
0.00801 - 0.01000	80.6k	281121	1%	T0
0.01001 - 0.01200	95.3k	289561	1%	T0
0.01201 - 0.01400	113 k	379065	1%	T2
0.01401 - 0.01600	130 k	379073	1%	T2
0.01601 - 0.01800	147 k	379081	1%	T2
0.01801 - 0.02000	162 k	379099	1%	T2
0.02001 - 0.02200	178 k	379107	1%	T2
0.02201 - 0.02400	196 k	379115	1%	T2
0.02401 - 0.02600	215 k	379123	1%	T9
0.02601 - 0.02800	232 k	257527	1%	T9
0.02801 - 0.03000	249 k	379131	1%	T9
0.03001 - 0.03200	267 k	379149	1%	T9
0.03201 - 0.03400	287 k	257543	1%	T9
0.03401 - 0.03600	301 k	379156	1%	T9
0.03601 - 0.03800	316 k	379164	1%	T9
0.03801 - 0.04000	340 k	379172	1%	T9
0.04001 - 0.04200	357 k	312793	1%	T9
0.04201 - 0.04400	374 k	379180	1%	T9
0.04401 - 0.04600	392 k	260455	1%	T9
0.04601 - 0.04800	412 k	379198	1%	T9
0.04801 - 0.05000	432 k	379206	1%	T9

Table 4-8. OFFSET VOLTAGE CORRECTION RESISTORS (FINE)

OFFSET VOLTAGE	FINE RESISTOR	J.F. P/N	TOL%	TEMPERATURE COEFFICIENT
0.00000 - 0.00010	None	------		
0.00011 - 0.00030	1.54k	289066	1%	T0
0.00031 - 0.00051	3.09k	235150	1%	T0
0.00051 - 0.00071	4.75k	260679	1%	T0
0.00071 - 0.00091	6.19k	283911	1%	T0
0.00091 - 0.00110	7.68k	370999	1%	T0
0.00110 - 0.00130	9.31k	379040	1%	T0
0.00131 - 0.00150	10.7k	293613	1%	T0
0.00151 - 0.00170	12.4k	261644	1%	T0
0.00171 - 0.00191	14.0k	379057	1%	T0
0.00191 - 0.00210	16.9k	267146	1%	T0

d. Remove the resistor/capacitor network and reconnect the short.

4-46. Offset Resistor Selection:

4-46a. Perform the test outlined in Figure 4-1 (Resistor Selection Procedure).

4-47. Buffer Amplifier Common Mode Rejection Ratio Test

a. Select the 20VDC range on the 8800A under test.

b. Connect the test equipment DVM LO input to the HIGH terminal of the 8800A under test.

c. Connect the test equipment DVM HIGH to TP6 on the 8800A under test.

d. Short the input terminals on the 8800A under test and note the readings.

e. Apply +21 volts DC ±21 mV to the 8800A under test.

f. The display on the 8800A under test read 18.8888 and flashes.

g. The change in the reading on the test equipment DVM is less than 40 microvolts from the value noted in step d above.

h. Repeat steps e thru g applying −21 volts ±21 mV.

i. If the 8800A under test is out of tolerance (a variation in excess of 40μV) the instrument is in need of repair. Refer to the paragraphs on Troubleshooting or return the instrument to your nearest Fluke Service Center.

4-48. TROUBLESHOOTING

4-49. The information given in the following paragraphs is provided to assist in isolating malfunctions in the 8800A. Before troubleshooting the instrument, however, it should be verified that the cause for the malfunction is actually in the instrument and not caused by faulty external equipments or improper control setting. For this reason, the performance test (paragraph 4-13) is suggested as the first step in troubleshooting. The performance test may also help to localize the trouble to a particular section of the instrument.

4-50. The following reminders of basic fault isolation will help determine if the cause is the result of an internal malfunction or faulty external connection.

a. Carefully check the 8800A control settings: some false indications may be caused by an incorrect or overlooked control setting.

b. Check associated equipment: insure the associated equipment controls and connections are correct.

c. Carefully inspect the interior of the instrument: check for physically damaged parts, loose or broken wires and improperly seated plug-in assemblies.

4-51. When it is determined, by the above checks, that the malfunction is within the 8800A the following procedure can be used to isolate the problem area. The recommended test equipment for troubleshooting is listed in Table 4-1.

4-52. Power Supply Check

4-53. Incorrect output voltages from any of the power supplies may cause the multimeter to exhibit various improper indications. The power supply voltages should be checked in the event of any instrument malfunction. Use the following procedure to check the voltage output of each power supply. Figure 4-2 illustrates where the connections are to be made for checking each supply.

a. Connect the test equipment voltmeter common lead to INPUT LO terminal.

b. Connect the test equipment voltmeter high input lead to TP7 (+18 volt supply). The supply output should be +18.02 ±0.05 volts.

c. Connect the test equipment voltmeter high input lead to TP8 (−18 volt supply). The supply output should be −18.02 ±0.10 volts.

d. Connect the test equipment voltmeter high input lead to the positive end of C18 (+35 volt supply). The supply output shoud be +35.0 ±5.0 volts (at 115V ac line voltage)

e. Connect the test equipment voltmeter high input lead to the negative end of C19 (−35 volt supply). The supply output should be −35.0 ±5.0 volts (at 115Vac line voltage).

f. Connect the test equipment voltmeter high input lead to TP9 and low input to TP8. The voltmeter should indicate +5.0 ±0.2 volts.

4-54. The +18 volt, +7 volt supplies all share a common reference provided by U9. The −18 volt supply receives operating dc voltage from the +18 volt supply. Problems occuring in one supply may cause improper operation of the others. The following procedure provides for open loop operation of the supplies to aid in localizing the defective supply.

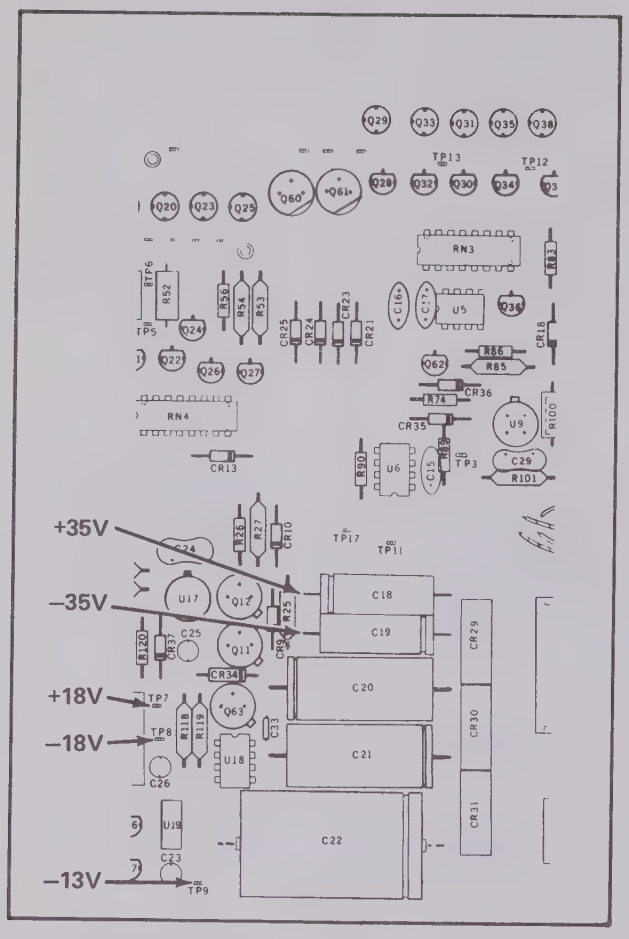


Figure 4-2. POWER SUPPLY VOLTAGE CHECK

a. Unsolder and lift one end of R120.

b. Short pins 3 and 4 of U17 together. This will utilize the internal reference of U17 for control.

c. Check the voltage outputs of the +18 volt supply, TP7 (this supply may be out of prescribed tolerance limits because of the change to the U17 internal reference), +7 volt supply TP11, –7 volt supply TP10 and –18 volt supply TP8.

d. Repair the faulty supply.

e. When all supplies are operating properly, remove the short from U17 pins 3 and 4, reconnect R120 and check the supplies for operation within specifications stated in Paragraph 4-50.

4-55. Integrated Circuit Replacement ⊗

4-56. CMOS and PMOS type integrated circuits require special handling whenever the IC is not installed in the circuit. This type integrated circuit can be destroyed by static electricity discharge. To prevent damage due to static discharge, the following precautions should be taken whenever IC's U13, U14, U15 or U20 on the main pcb or any IC on the DOU (–02 option) is handled.

a. The PMOS or CMOS integrated circuit leads are imbedded in conductive foam. Do not remove the conductive foam from the integrated circuit until ready for installation into the unit.

b. Be sure the repairing personnel and the unit under repair are commonly grounded before the integrated circuit is put in place in the unit.

c. Be sure the soldering iron used is grounded to the common ground of the unit under repair.

4-57. Fault Area Isolation

4-58. A malfunction in the 8800A may be isolated to a particular section of circuitry by observing the displayed symptoms during the multimeter operation in each function. The results of the Performance Tests (paragraph 4-15) will indicate the multimeter functions affected by the malfunction. The problem areas, indicated by the various improper functional displays, are presented in Table 4-9. Four vertical columns, describing the 8800A operational status in each of the three functions as being either proper or improper, indicate the functional area of the multimeter where the problem is most likely to be found. Close observation of the symptoms displayed on the front panel coupled with a knowledge of the theory of operation (Section 3) may further define the problem area.

4-59. Troubleshooting information for each functional area is presented in the following paragraphs. Proceed to the paragraphs that provide the troubleshooting information for the problem area indicated by the fault area isolation procedure. Keep in mind, however, that a malfunction within one functional area may affect the operation of another.

4-60. AC CONVERTER

4-61. Generally a failure in the AC Converter will do one of two things: 1) create a dc voltage output without an ac input signal applied or 2) not produce the proper dc voltage for the A/D Converter when an ac input signal is applied. A dc output generated by the AC Converter will cause the multimeter display to indicate some value of ac voltage, in the two highest ranges, when a short is placed across the input terminals. When the AC Converter failure causes the display to remain at zero when an ac

Table 4-9. PROBLEM AREA ISOLATION

8800A FUNCTION	8800A OPERATION IN EACH FUNCTION IS –			
DC V AC V OHMS	PROPER IMPROPER PROPER	IMPROPER PROPER IMPROPER	PROPER PROPER IMPROPER	IMPROPER IMPROPER IMPROPER
PROBLEM AREA INDICATED	AC CONVERTER	VDC BUFFER	OHM CONVERTER	A/D CONVERTER OR CONTROL AND DISPLAY

signal is applied to the input, the converter is not producing the proper dc voltage output for the A/D Converter.

4-62. The following procedure should be used when troubleshooting those failures that cause an apparent offset voltage from the AC Converter.

a. Remove the molded plastic outer cover and top guard cover from the 8800A. (See paragraph 4-7 Access/Disassembly)

b. Remove the Ohms Converter pcb to provide room for troubleshooting the AC Converter. This does not affect the ac operation of the instrument.

c. Connect the 8800A to ac line power, turn the unit on, and select the VAC function and 2 volt range.

d. Connect the Low input lead of a test equipment multimeter to the 8800A INPUT - Ω SENSE LO terminal and the high lead to J5 pin 10 (AC Converter output).

e. Short the 8800A input high to low terminals.

f. The dc voltage output at J5 pin 10 should be close to zero volts dc.

4-49. A dc voltage output at J5 pin 10 of more than approximately 100 mV, either positive or negative, indicates a failure within the AC Converter. A converter output voltage of two volts dc or greater will cause the 8800A display to read full scale (a flashing display of 188888). Improper output voltage levels approximately equal to the +18 volt or –18 volt supply are generally caused by failures of Q1, Q2, CR6, U1, or there associated components. Lower level offsets are generally caused by feedback loop failures. Improper operation of Q4, Q5, Q6, or associated components would not only cause a zero offset but would also add the value of that offset to all ranges of ac voltage measurements.

4-64. When the AC Converter failure causes the 8800A display to indicate zero volts when ac inputs are applied to the instrument use the following procedure to locate the malfunction.

a. Remove the molded plastic outer cover and top guard cover from the 8800A. (See paragraph 4-7 Access/Disassembly)

b. Remove the Ohms Converter pcb to provide room for troubleshooting the AC Converter. This does not affect the ac operation of the instrument.

c. Connect the 8800A to ac line power, turn the unit on and select the VAC function and 2 volt range.

d. Connect the signal return of an oscilloscope to the LO INPUT terminal and the input probe to the connection at either end of the red and white AC Converter input wire.

e. Apply a one volt rms sinusoidal 10 kHz signal to the 8800A input terminals.

f. Note the oscilloscope trace (amplitude and frequency).

g. Move the oscilloscope input probe to the junction point of R17 and R18.

h. The oscilloscope trace should be approximately one-quarter of the input signal amplitude and 180° out-of-phase.

i. If this signal is not correct move the oscilloscope input probe to the junction point of CR3 and the emitter of Q2.

j. The oscilloscope trace should be as described in step h.

4-65. If the wave forms are correct at both points, the probable cause for the lack of an AC Converter output would be a shorted C16 or C17, or an open Q7. Incorrect wave form; asymmetrical, distorted, or of wrong amplitude, can generally be attributed to improper operation of Q1, Q2, CR6 or U1.

4-66. VDC BUFFER

4-67. The 8800A front panel display will generally indicate a buffer malfunction in one of three ways. First, the display presents an over range indication (flashing +188888) for all inputs applied to the instrument. Second, the display will not indicate any applied dc input; producing a displayed readout of 000000 plus two or three digits of noise. Third, the display indicates that some value of offset if being added to all inputs. This offset malfunction will usually produce a display indication even without an input applied to the instrument.

4-68. Malfunctions within the VDC Buffer may cause the display to be improper on one or two ranges and correct on the others. The overall gain of the buffer is changed for each range. Table 4-10 lists the five dc voltage ranges and the components that control the circuit configuration to produce the proper gain for each range. Noting the range or ranges affected by the malfunction may point to the gain control component or associated circuitry causing the problem.

4-69. If the VDC Buffer malfunction affects all ranges, the following procedure will help isolate the problem. Remove the 8800A outer cover and top guard cover. Select the VDC function and 2V range for this test.

a. Place a short across the 8800A input terminals.

b. Short TP4 and INPUT LO. This will prevent the bootstrap amplifier (U2 and Q16) from driving the buffer into saturation.

c. Using the test equipment multimeter check the voltage drop across CR11, then CR12. The voltage drop should be approximately 6.2V dc each. If the voltage drop is significantly higher or lower across one diode the positive supply (CR9, Q11) or negative supply (CR10, Q12) may be defective.

d. Connect the test equipment multimeter low input to the LO INPUT terminal and the high input to TP6. The voltage level should be about zero. Any voltage present, which cannot be zeroes by the front panel control, is being caused by a malfunction with U1, Q14, Q13, Q15 or associated circuitry.

e. If the voltage level at TP6 is zero, remove the short from the 8800A input terminals and apply +0.2 volts dc to the input. TP6 should provide a +0.2V dc indication also. TP6 should track any change in the input up to about 0.5V dc. Any failure of TP6 to track the input is being caused by U1, Q14, Q13, Q15 and associated circuitry or a short through Q10 or CR6.

f. If all the above indications are correct, the probable cause of the malfunction is Q16, U2, or associated circuitry.

Table 4-10. VDC BUFFER GAIN CONTROL

RANGE	Q18	Q25	Q23	Q20	K5	TOTAL BUFFER GAIN
200 mV	open	closed	open	closed	open	10
2 V	closed	closed	open	open	open	1
20 V	closed	open	closed	open	open	.1
200 V	closed	closed	open	open	closed	.01
1200V	closed	open	closed	open	closed	.001
	Q18, closes to provide a gain of one across Q14, Q15 & U1	Q25, closes to present full buffer output to A/D	Q23, closes to divide the buffer output by 10	Q20, closes to increase the gain of Q14, Q15 & U1 by 10	K5, closes to divide the buffer input by 100	

4-70. OHMS CONVERTER

4-71. Use the following procedure when troubleshooting malfunctions within the Ohms Converter. Remove the 8800A from the outer case. Remove the top inner guard cover. Select the kΩ function and the 200Ω range.

a. Connect a one ohm resistor across the Ω source terminals.

b. Measure the voltage drop across the one ohm resistor. The ohms converter should supply enough current to develop 1 ±0.3mV across the resistor.

c. If the voltage across the resistor is less than 0.8 mV short across Q2 emitter to collector. The voltage across the resistor should now be 0.8 mV or greater. If it is Q21, Q1, Q2 or CR12 is causing the malfunction.

d. Overrange indications in the ohms function can be caused by a failure of Q6 to close and apply the reference voltage to the A/D Converter. Q6 may either be open or the gate signal may not be present during the read period.

e. Select the 10k range

f. Measure the voltage drop across R29. The inverter should supply enough current to develop -6.7 mV ±0.2 mV across R29.

g. If the voltage is less than -6.5 mV the problem is contained within the inverter, Q24, Q25, or the clock input, which should be 1 MHz.

h. If the inverter checks out, test the voltage dropped across R26. The voltage across R26 should be -3V ±0.3. If the voltage does not meet this spec, then the trouble is contained within the regulator, (Q22, Q23) and their associated component, or Q8, Q6, and Q4).

4-72. A/D CONVERTER OR CONTROL AND DISPLAY

4-73. If the display symptoms observed during the fault area isolation procedure indicate that the problem is either in the A/D Converter or Control and Display the following procedure should aid in locating the faulty component. Because the timing of the control signals used to process the input signal through the A/D Converter and Display circuits is critical to the proper operation of these sections an oscilloscope should be used to make the voltage and signal checks.

4-74. The A/D Converter operation can be checked using the following procedure.

a. Select the VDC function and 2 volt range.

b. Apply +1 volt dc to the 8800A input terminals.

c. Measure the input to the A/D Converter at TP13. The voltage, TP13 high to the INPUT LO terminal, should be 1 volt dc.

NOTE

Connect the oscilloscope external sync. input via a X10 probe to TP16 during the remainder of this procedure. The scope control settings are provided on the wave shape illustration.

d. Connect the scope input to TP1 and return to the INPUT LO terminal. The scope display should be as shown in Figure 4-3.

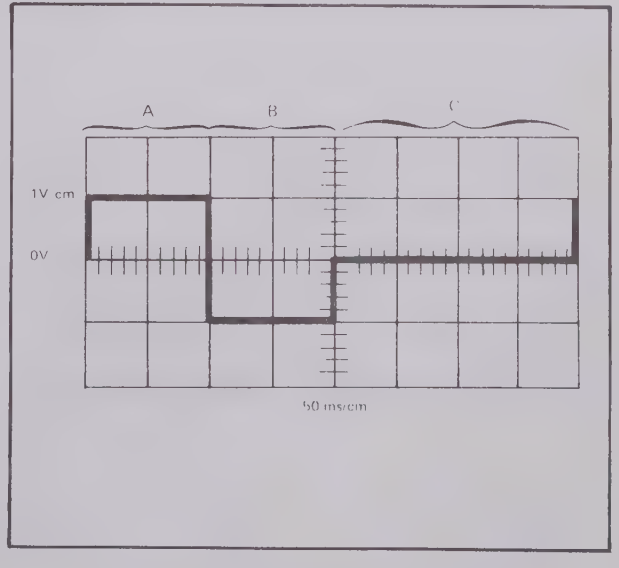


Figure 4-3. TP1 WAVE FORM

4-75. The waveform at TP1 can indicate several possible problems in the circuitry. The 100 ms period designated A is the integrate period during which the unknown 8800A input (in this case 1 volt) is applied to the integrator (Q40 and U4). The 100 ms time designated B is the read period when the reference (in this case −1 volt) is applied to the integrator. The length of period B (read) will change with a change in voltage level applied to the 8800A input within the range selected. The section designated C is the auto-zero period during which the A/D Converter input is shorted to ground, via Q38, to insure that the A/D starts from zero for each new integrate period.

4-76. If the 1 volt input during period A is not present, Q38 may be shorting the input to ground or Q31 may not be closing to apply the buffer output to the A/D. Time period B may indicate that the reference is low by not going to −1 volt. A low reference supply would also cause period B to legthen. If the voltage level during time period B is unstable, the reference supply input FET Q35 or control Q34 may be faulty.

4-77. If the wave form at TP1 presents the proper 100 ms +1 volt indication during A then drops to −1 volt at the start of B but remains at −1 volt through C, the A/D Converter may not be supplying the control IC (U11) with the compare signal (CM). The compare signal can be checked at TP17 using the following procedure.

a. Connect the oscilloscope input to TP17.

b. The scope presentation shown in Figure 4-4 represents the proper compare signal for an 8800A input of +1 volt dc.

c. If this signal is present at TP17 proceed to control signal troubleshooting paragraph 4-81.

d. If the compare pulse is not present or incorrect, either in amplitude or timing of the leading edge make the following check.

e. Move the oscilloscope input to TP2. The scope presentation should be as shown in Figure 4-5.

4-78. The probable cause for an improper signal at TP2 would be a failure in Q40 or U4. If the voltage level remains at zero volts the protection transistor Q59 may be shorted or input FET Q39 open.

4-79. The timing signals that control the processing of inputs applied to the 8800A are developed within the custom I.C., U11. A 1 MHz crystal (Y1) provides the base frequency from which the timing control signals are produced. Figure 4-6 illustrates the timing relationship between the control signals (INT., DE(+R), AZ, and $\Delta 2$), as they appear at RN3, and the integrator signal at TP2. An incorrect or missing control signal at RN3 may be caused by a failure in the logic control gates U13, U14, or U15.

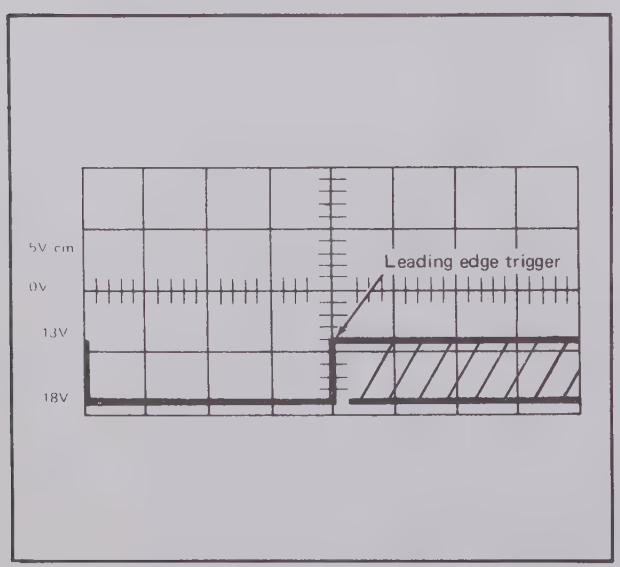


Figure 4-4. TP17 COMPARE SIGNAL

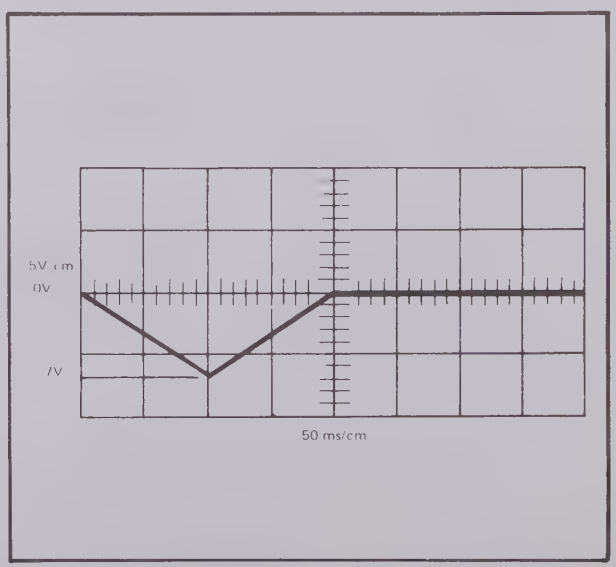


Figure 4-5. A/D INTEGRATOR OUTPUT

4-80. The logic control gates (U13, U14, and U15) and the custom integrated circuit U11 use the 5 volt difference in potential between the −18 volt supply and −13 volt supply for the logic control signal levels. The recommended method for observing the logic signals in this area is to attach the oscilloscope return to the INPUT LO terminal and watch the logic signals for level changes between −18 volt and −13 volt levels.

CAUTION

The oscilloscope return has been connected to the INPUT LO terminal for the waveform checks. For observation of the control signals on the pins of U11 or logic control gates (U13, U14, and U15) the oscilloscope return can be connected to TP8, the −18 volt supply. If this connection is made insure that the oscilloscope return will not ground the −18 volt power supply. Damage to the 8800A circuitry WILL result from grounding TP8.

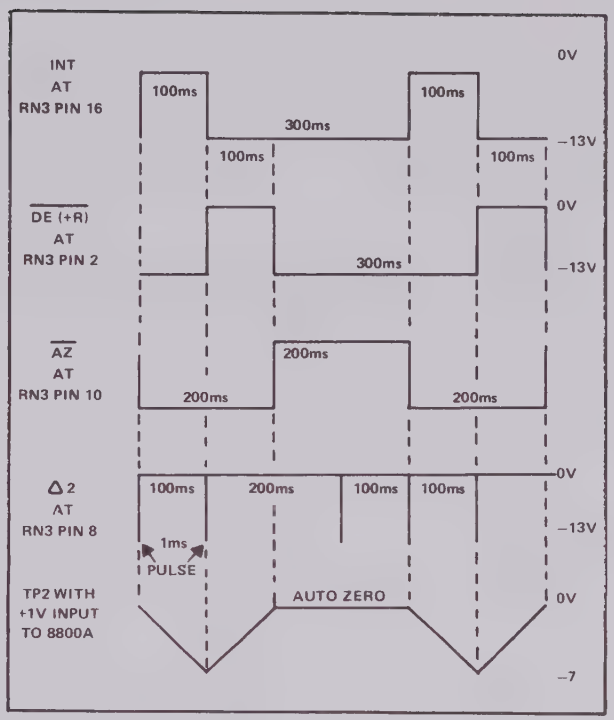


Figure 4-6. A/D CONVERTER CONTROL SIGNAL TIMING

Section 5
Lists of Replaceable Parts

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5-7	DOU PCB	Option –02	5-24

5-1. INTRODUCTION

5-2. This section contains an illustrated parts breakdown of the instrument. Components are listed alpha-numerically by assembly. Electrical components are listed by reference designation and mechanical components are listed by item number. Each listed part is shown in an accompanying illustration.

5-3. Parts lists include the following information:

a. Reference Designation or Item Number.

b. Description of each part.

c. Fluke Stock Number.

d. Federal Supply Code for Manufacturers. (See Appendix A for Code-to-Names list.)

e. Manufacturer's part Number or Type.

f. Total Quantity per assembly or component.

g. Recommended Quantity: This entry indicates the recommended number of spare parts necessary to support one to five instruments for a period of two years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for one year or more at an isolated site, it is recommended that at least one in each assembly in the instrument be stocked. In the case of optional subassemblies, plug-ins, etc. that are not always part of the instrument, or are deviations from the basic instrument mode, the REC QTY column lists the recommended quantity of the item in that particular assembly.

h. Use Code is provided to identify certain parts that have been added, deleted or modified during production of the instrument. Each part for which a use code has been assigned may be identified with a particular instrument serial number by consulting the Use Code Effictivity, paragraph 5-7.

5-4. HOW TO OBTAIN PARTS

5-5. Components may be ordered directly from the manufacturer by using the manufacturer's part number, or from the John Fluke Mfg. Co., Inc. factory or authorized representative by using the FLUKE STOCK NUMBER. In the event the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

5-6. To ensure prompt and efficient handling of your order, include the following information.

a. Quantity.

b. FLUKE Stock Number.

c. Description.

d. Reference Designation or Item Number.

e. Printed Circuit Board Part Number.

f. Instrument model and Serial number.

5-7. USE CODE EFFECTIVITY LIST

USE CODE	SERIAL NUMBER EFFECTIVITY
A	123 to 250000
B	250000 and on
C	123 to 656000
D	656000 and on

Table 5-1. FINAL ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	FINAL ASSEMBLY Figure 5-1	8800A					
A2	**Main PCB Assembly (Table 5-2)**	366245	89536	366245	1		
A3A1	**Display Assembly (Table 5-3)**	366278	89536	366278	REF		
A4	**Ohms Converter Assembly (Table 5-4)**	366302	89536	366302	1		C
A4	**Ohms Converter II Assembly (Table 5-5)**	456106	89536	456106	1		D
A5	**AC Converter Assembly (Table 5-6)**	366336	89536	366336	1		
F1	Fuse, 1/4 Amp, 250V (includes spare F1)	109314	71400	AGC	2		
T1	Xfmr	373977	89536	373977	1		
U11	IC, Universal DVM, LSI 1				1		
XF1	Fuseholder	103283	71400	4405	1		
1	Battery, cover 2	395087	89536	395087	1		
2	Case, molded	363655	89536	363655	1		
3	Chassis, Side Assembly	372227	89536	372227	1		
4	Chassis, Side	388264	89536	388264	1		
5	Crank and Rod Assembly	378968	89536	378968	1		
6	Decal handle, molded	381567	89536	381467	1		
7	Decal, Gen. Spec	380402	89536	380402	1		
8	E Retaining Ring	168914	79136	5133-15-MDR	1		
9	Guard, bottom (Not illustrated)	364901	89536	364901	1		
10	Guard, insulator	384289	89536	384289	2		
11	Guard, top	365189	89536	365189	1		
12	Guard, Xfmr	365114	89536	365114	1		
13	Handle, molded	363648	89536	363648	1		
14	Lens	401604	89536	401604	1		
15	Line cord (Not illustrated)	343723	82839	TYPE SPH386	1		
16	Line switch	380121	89536	380121	1		
17	Pad, foot	338632	89536	338632	1		
18	Screw, 6-20 x 3/8	288266	89536	288266	2		

Table 5-1. FINAL ASSEMBLY (Concluded)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
19	Washer, Flat	340505	89536	340505	2		
20	Washer, Spring	228981	89536	228981	4		
21	Washer, squarehole	370171	89536	370171	2		
22	Test Leads, Set (Not illustrated)	343657	83330	21058	1		
U11	IC, Universal DVM, P-MOS	1	1	1	1		
3	Panel, front, molded	363663	89536	363663	1		
4	Actuator, SW, putty grey	420604	89536	420604	10		
25	Actuator, SW, green	364729	89536	364729	1		
26	Binding post, red	275552	32767	825-65	2		
27	Binding post, black	275560	32767	825-45	2		
28	Binding post, blue	275578	32767	825-55	1		
29	Decal I, front panel	376764	89536	376764	1		
30	Decal II, front panel	376772	89536	376722	1		
31	Shorting link	101220	24655	0938-9712	3		
32	Connector Tab	267609	00779	60837-1	1		

1 If replacement of custom chip U11 is necessary, refer to paragraph 4-17.

2 This part is deleted for instruments with a use code of D and on.

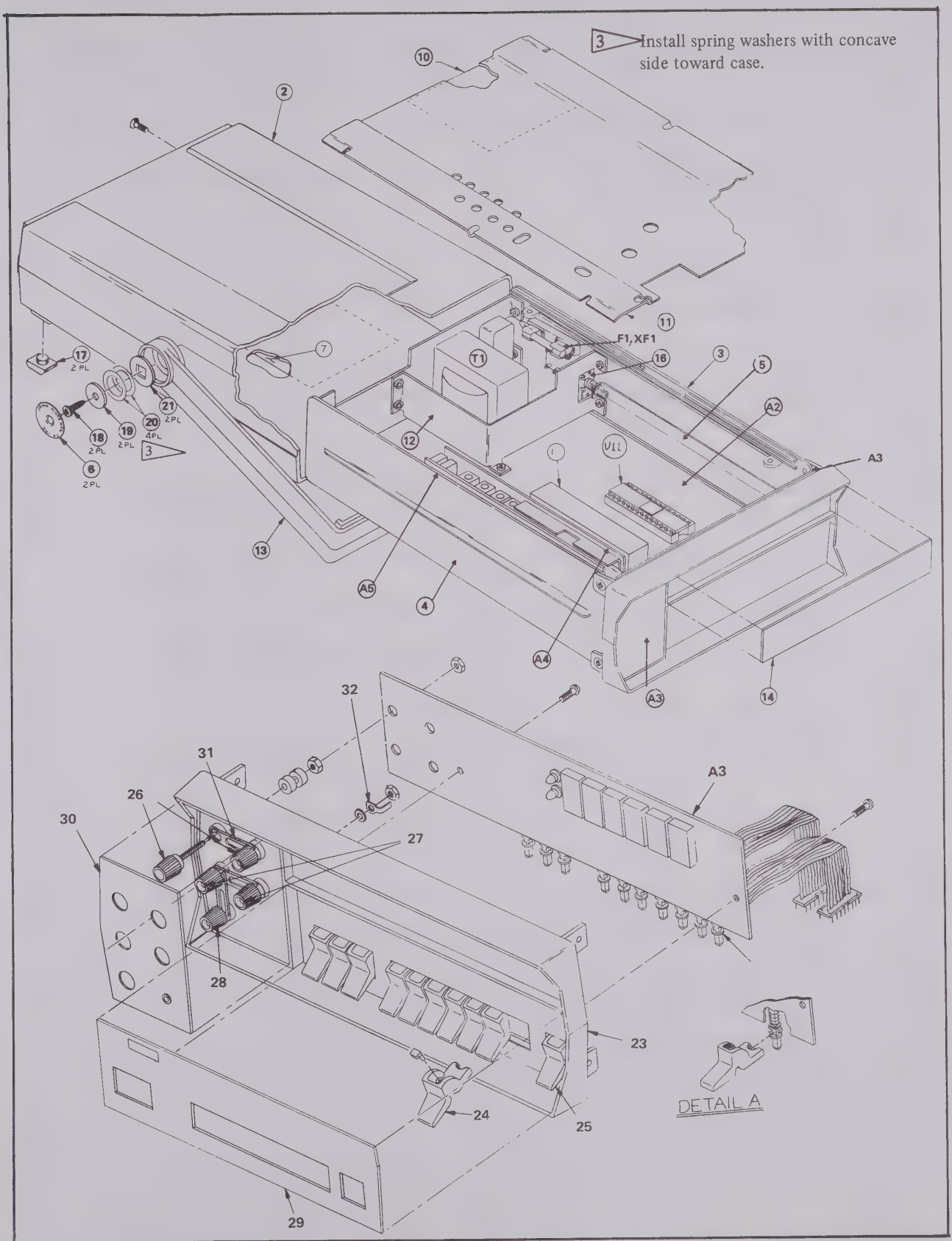

Figure 5-1. FINAL ASSEMBLY

Table 5-2. MAIN PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A2	MAIN PCB ASSEMBLY Figure 5-2	366245	89536	366245	REF		
C1,C14	Not Used						
C2	Cap, plstc, 0.022uF ±10%, 100V	333823	84411	863UW22391	1		
C3, C4	Cap, cer, 0.005 uF ±20%, 50V	175232	56289	C023B101E502 M	2		
C5, C6, C10, C12	Cap, mica, 150 pF ±5%, 500V	148478	30800	39C10HH43	4		
C7,C11, C27, C28, C33	Cap, cer, 33 pF ±2%, 100V	354852	32897	8121A100C0G3 30G	5		
C8	Cap, poly car, 0.10 uF ±10%, 100V	376251	73445	C280MCH/A100 K	1		
C9	Cap, poly prop, 0.47 uF ±5%, 50V	364042	01281	JF78B	1		
C13	Cap, poly car, 2.2 uF ±10%, 250V	306522	73445	C280MCH/A2M 2	1		
C15	Cap, cer, .0012 uF ±10%, 500V	106732	71590	CF122	1		
C16, C17	Cap, cer, 0.22 uF ±20%, 50V	309849	71590	CW30C224K	2		
C18, C19	Cap, elect, 50 uF +75/–10%, 50V	105122	56289	30D506G050D D4	2		
C20, C21	Cap, elect, 220 uF +50/–10%, 40V	178616	73445	ET221X040A01	2		
C22	Cap, elect, 4000 uF +100/–10%, 10V	330761	25088	B41010-4700/10	1		
C23, C25, C26	Cap, Ta, 4.7 uF ±20%, 20V	161943	56289	196D475X0025 JA1	3		
C24	Cap, mica, 100 pF ±5%, 500V	148494	30800	CM05FD271J03	1		
C29	Cap, mica, 270 pF ±5%, 500V	148452	14655	CD15FD271J03	1		
C30	Not Used						
C31	Cap, mini cer, 68 pF ±2%, 100V	362756	80031	222263110689	1		

Table 5-2. MAIN PCB ASSEMBLY (Continued)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
C32	Cap, mini cer, 15 pF ±2%, 100V	369074	80031	222263110159	1		
CR1 thru CR5	Not Used						
CR6	Diode, Si	180554	07910	TD 12599	1		
CR7, CR8	Diode, zener, 22V	181073	07910	1N969B	2		
CR9, CR10	Diode, Si, Multi-pellet	375485	09214	MPD300	2		
CR11, CR12, CR35, CR36	Diode, zener, 6.2V	325811	07910	1N735A	4		
CR13	Diode, zener, 13V	110726	07910	1N964B	1		
CR14, CR15, CR17	Not Used						
CR16, CR18 thru CR26, CR32, CR33 CR39	Diode, Si, hi-speed	203323	07910	1N4148	13		
CR27, CR28	Not Used						
CR29, CR30, CR31	Diode, bridge	296509	09423	FB200	3		
CR34, CR38	Diode, zener, 10V	113324	07910	1N961A	2		
CR37	Diode, 2 pellet	375477	09213	MPD200	1		
K5	Relay, telephone type, 2-pole	357707	26806	AZ42012201	1		
Q1 thru Q9	Not Used						
Q10, Q13, Q59	Xstr, NPN	168716	12040	ST07154	3		

Table 5-2. MAIN PCB ASSEMBLY (Continued)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
Q11, Q63	Xstr, PNP	269076	04713	2N4890	2		
Q12	Xstr, NPN	150359	86684	2N3053	1		
Q14	Xstr, Si, NPN	295717	24355	AD81100-17	1		
Q15	Xstr, Dual, NPN	284075	32293	1T1099	1		
Q16, Q19, Q21, Q24, Q26, Q28, Q30, Q32, Q34, Q36, Q37, Q43, Q44, Q46, Q48, Q50, Q52, Q54, Q56, Q57	Xstr, Si, NPN	218396	04713	2N3904	20		
Q18, Q20, Q23, Q25	Xstr, FET, N-channel	370072	12040	KE4393	4		
Q22, Q27, Q42, Q58	Xstr, Si, PNP	195974	04713	2N3906	4		
Q29, Q31, Q33, Q35, Q38, Q41	Xstr, FET, N-channel	343830	89536	343830	6		
Q39	Xstr, FET	386730	12040	SF51102	1		
Q40	Xstr, FET, dual	257501	17856	DN423	1		

Table 5-2. MAIN PCB ASSEMBLY (Continued)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
Q45, Q47, Q49, Q51, Q53, Q55	Xstr, Si, PNP	340026	04713	MPS6563	6		
Q60, Q61	Xstr, Si, PNP	203364	07263	2N3638	2		
Q62	Xstr, Si, NPN	218081	04713	MPS6520	1		
RN1	Res, network,	379248	89536	379248	1		
RN3	Res, network,	379255	89536	379255	1		
RN4	Res, network,	379230	89536	379230	1		
RN5	Res, network,	358002	01121	FN260	1		
R1 thru R20	Not used						
R21	Res, var, 200 ±10%, ½W	275743	71450	360T200A	1		
R23	Res, comp, 100k ±5%, 2W	285056	01121	HB1045	1		
R25	Res, mf, 383 ±1%, 1/8W	375899	91637	MFF1-83830F	1		
R26	Res, mf, 62k ±5%, 1/4W	348904	80031	CR251-4-5P62K TS	1		
R27	Res, mf, 205 ±1%, 1/8W	325647	91637	MFF1-82050F	1		
R28, R32	Res, car, 220 ±5%, 1/4W	342626	80031	CR251-45P220ET5	2		
R29	Res, comp, 100M ±10%, 1/2W	190520	01121	EB1071	1		
R30	Res, var, 100k ±10%, 1/2W	369520	71450	360T104A	1		
R31	Res, mf, 499k ±1%, 1/8W	268813	91637	MFF1-84993F	1		
R33, R36	Res, mf, 309k ±1%, 1/8W	235283	91637	MFF1-83093F	2		
R35, R39	Res, set 2 pc	290320	89536	290320	1		
R37	Res, var, 2k ±10%, 1/2W	285163	71450	360S202A	1		

Table 5-2. MAIN PCB ASSEMBLY (Continued)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R40	Res, mf, 2.8M ±1%, 1/2W	236703	91637	MFF1-22804F	1		
R41, R43, R116	Res, car 10k ±5%, 1/4W	348839	80031	CR251-45P10K T-S	3		
R42	Res, car, 150 ±5%, 1/4W	343442	80031	CR251-4-5P150 ETS	1		
R45, R56, R117	Res, car, 1M ±5%, 1/4W	348987	80031	CR251-4-5P1M TS	3		
R47	Res, var, 20 ±20%, ½W	275727	71450	360T200B	1		
R48, R52	Res, set, 2 pc	363788	89536	363788	1		
R53	Res, mf, 100k ±1%, 1/8W	248807	91637	MFF1-81003F	1		
R54	Res, mf, 9.76k ±1%, 1/8W	241489	91637	MFF1-89761F	1		
R55	Res, car, 1.5k ±5%, 1/4W	148031	01121	CB1525	1		
R74	Res, car, 4.7k ±5%, 1/4W	348821	80031	CR251-45P4KTS	1		
R75	Res, mf, 30.9k ±1%, 1/8W	235275	91637	MFF1-83092F	1		
R76	Res, comp, 10M ±5%, 1/4W	194944	01121	CB1065	1		
R77, R80	Res, mf, 64.9k ±1%, 1/8W	288530	91637	MFF1-86492F	2		
R78	Res, var, 200 ±10%, ½W	285148	71450	360S201A	1		
R79	Res, mf, 46.4k ±1%, 1/8W	188375	91637	MFF1-84642F	1		
R83	Res, car, 51k ±5%, 1/4W	376434	80031	CR251-4-5P51 KT	1		
R84	Res, mf, 4.99k ±1%, 1/8W	168252	91637	MFF1-84991F	1		
R85	Res, mf, 200k ±1%, 1/8W	261701	91637	MFF1-82003F	1		
R86	Res, car, 3.3k ±5%, 1/4W	348813	80031	CR251-45P3K3TS	1		
R87	Res, car, dep, 2.7k ±5%, 1/4W	386490	80031	CR251-45P2K7TS	1		
R88	Res, car, 5k ±10%, 1/2W	288282	71450	360S502A	1		

Table 5-2. MAIN PCB ASSEMBLY (Continued)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R89	Res, car, 100 ±5%, 1/4W	348771	80031	CR251-4-5P100-ETS	1		
R90, R120	Res, car, 2.2k ±5%, 1/4W	343400	80031	CR251-45P2K-2TS	2		
R91 thru R95, R98	Res, Set, 6 pc	363804	89536	363804	1		
R96, R102, U9	Ref amp, set	450080	89536	450080	1		
R97, R99	Res, var, 20 ±20%, ½W	285114	71450	360S200B	2		
R100	Res, cub mini, ww, 14.. ±0.1%, 1W	363770	54294	SP21D22-14KB	1		
R101	Res, mf, 3.74k ±1%, 1/8W	272096	91637	MFF1-83741F	1		
R103	Res, mf, 6.34k ±1%, 1/8W	267344	91637	MFF1-86341F	1		
R112	Not Used						
R113	Res, mf, 5.49k ±0.1%, 1/8W	375873	91637	MFF1-85491-R1PCT	1		
R114	Res, mf, 3.48k ±0.1%, 1/8W	375881	91673	MFF1-83481-R1PCT	1		
R115	Res, mf, 10k ±1%, 1/8W	168260	91637	MFF1-81002F	1		
R118, R119	Res, mf, 10.08k ±0.1%, 1/8W	346908	91537	MFF1-810R8-R1PCT	2		
S12	Switch, slide, 115/230V	376798	82389	11A437	1		
TP1 thru TP14, TP16, TP17, Y	Conn, post	379438	00779	8619405	17		
U1, U7	IC, Op amp	284760	12040	LM308H	2		
U3	IC, op amp, J-FET, Input	381962	12040	SH61140	1		
U2	IC, Op amp, J-FET, Input	448985	89536	448985	1		
U4, U18	IC, Op amp, ext comp	363515	24355	AD301AN	2		
U5	IC, Op amp, met can	329912	12040	LM318H	1		
U6	IC, Linear, vol comparator	352195	32293	LM311PA	1		
U8	IC, Op amp	225961	34333	SG8023	1		
U11	Part of Final Assembly						
U12	IC, BCD-to-Decimal Decoder	293142	01295	SN7442N	1		

Table 5-2. MAIN PCB ASSEMBLY (Concluded)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U13	IC, C-MOS, Hex ⊗	355214	95303	CD4009AE	1		
U14	IC, C-MOS, NAND ⊗	375147	95303	CD4023AE	1		
U15	IC, C-MOS, NAND ⊗	355198	95303	CD4011AE	1		
U16	IC, TTL, BCD Decoder/Driver	340109	01295	SN7447AN	1		
U17	IC, Linear, Vol Reg	313106	07263	U5R7723393	1		
U19	IC, Linear, Vol Reg	355107	07263	F7805UC	1		
U20	IC, C-MOS, multi ⊗	375808	95303	CD4053AE	1		
W2	Wire Assy, Black (8800A-4001)	373779	89536	373779	1		
W3	Wire Assy, Blue (8800A-4009)	378307	89536	378307	1		
W9	Wire Assy, Red (8800A-4008)	378299	89536	378299	1		
XK5	Socket relay	376665	12300	27E501	1		
Y1	Crystal Teletype, 2 pole	375493	89536	375493	1		
	Conn, post	376574	00779	5166-333-68	16		
	Heat Sink, Xstr	370155	05820	204-CB	5		
	Socket, 40 pin	376244	23880	TSA3100-40W	1		
	Socket, 16 pin	276535	23880	TSA2900-16W	3		
	Socket, 14 pin	276527	23880	TSA2900-14W	4		
	Terminal, feed thru	281865	12615	SL841-777	2		
	Transipad, Xstr	152207	07047	10123-DAP	5		

⊗ Indicates MOS device which may be damaged by static discharge.

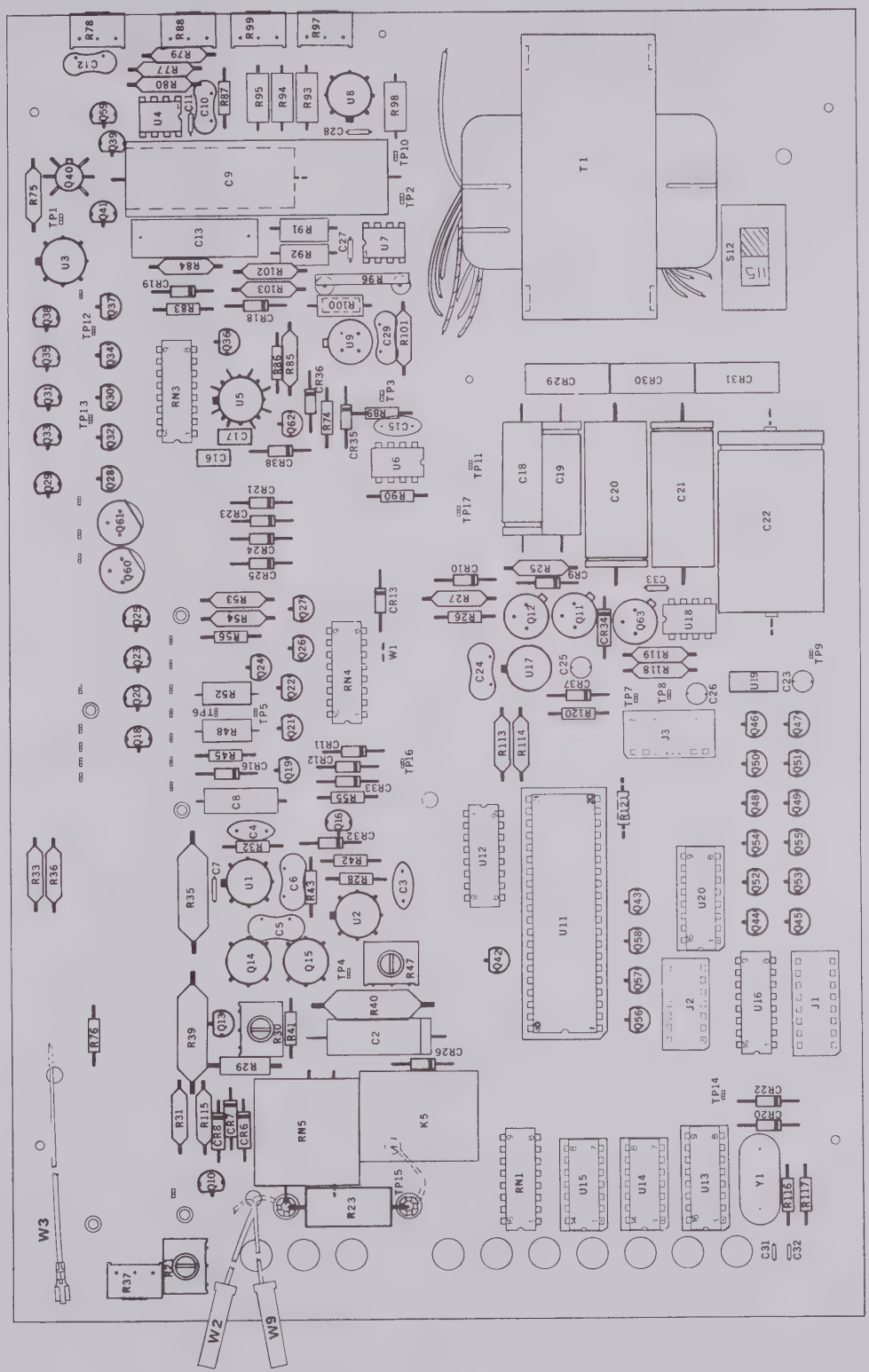

Figure 5-2. MAIN PCB ASSEMBLY

Table 5-3. DISPLAY ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A3	**DISPLAY ASSEMBLY** **Figure 5-3**	366278	89536	366278	REF		
C1	Cap, cer, 47pF ±10%, 2kV/3.5kV	282145	00656	HVD347P10 PCT	1		
CR2, CR3	Diode, LED	385914	89536	385914	2		
DS1	Display, LED	380444	50579	DL707-812	1		A
DS1	Display, LED	418400	03203	29083			B
DS2 thru DS6	Display, LED	380436	50579	DL707-811	4		A
	Display, LED	418392	03202	29083	4		B
P1	Cable Assy, 16P	380576	89536	380576	1		
P2	Cable Assy, 14P	380568	89536	380568	1		
RN1	Res, network	381376	89536	381376	1		
S1 thru S10	Switch Assy	390500	89536	390500	1		
	Conn, post	379438	00779	86144-5	9		

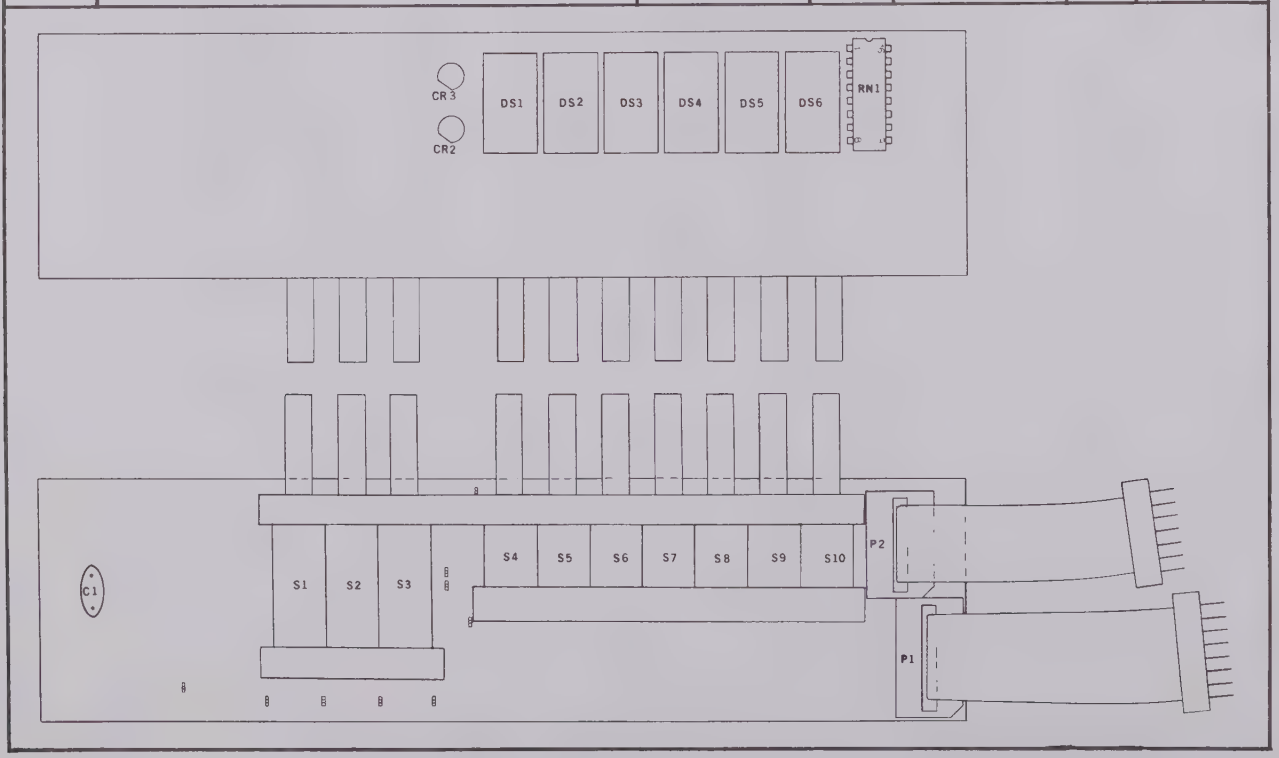

Figure 5-3. DISPLAY ASSEMBLY

Table 5-4. OHMS CONVERTER ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A4	OHMS CONVERTER ASSEMBLY Figure 5-4	366302	89536	366302	REF		C
BT1, BT2	Battery, Alkaline, 1.5V	376756	90303	MN1500	2		
C1	Cap, plstc. .022 uF ±10%, 100V	333823	84411	863UW22391	1		
CR1	Diode, multi-pellet, Si	375477	09214	MPD200	1		
CR2	Not Used						
CR3	Diode	112383	05277	SCE6	1		
CR4, CR5	Diode, Si, hi-speed switching	203323	07910	1N4148	2		
K1 thru K4	Relay, reed, spst, 4.5V	357582	71707	UF40070	4		
Q1	Xstr, Si, PNP	195974	04713	2N3906	1		
Q2	Xstr, NPN	218511	89536	218511	1		
Q3, Q7, Q17	Xstr, NPN	168716	12040	ST07154	3		
Q4, Q6, Q8	Xstr, J-FET	343830	89536	343830	3		
Q5, Q9	Xstr, NPN	218396	04713	2N3904	2		
RN6	Res, network	363796	89536	363796	1		
R1	Res, car, 22k ±5%, 1/4W	348870	80031	CR251-4-5P22-KT5	2		
R2, R16, R17, R18	Res, car, 1M ±5%, 1/4W	348987	80031	CR251-45P1MT-S	4		
R3	Res, car, 562 ±1%, 1/4W	340828	91637	MFF1-85620F	1		
R4, R7, R9	Not Used						
R5	Res, var, 50k ±10%, 1/2W	288290	71450	360S503A	1		
R6	Res, var, 2k ±10%, 1/2W	285163	71450	360S202A	1		
R8	Res, var, 100 ±10%, ½W	285130	71450	360S101A	1		
R10	Res, var, 100k ±10%, 1/2W	288308	71450	360S104A	1		

Table 5-4. OHMS CONVERTER ASSEMBLY (Concluded)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R11	Res, mf, 1M ±1%, 1/8W	268797	91637	MFF1-81004 F	1		
R12	Res, car, 33k ±5%, 1/4W	348888	80031	CR251-45P33K TS	1		
R13	Res, var, 10k ±10%, 1/2W	285171	71450	360S103A	1		
R14	Res, mf, 95.3k ±1%, 1/8W	289561	91637	MFF1-89532F	1		
R19	Res, car, 150k ±5%, 1/4W	348938	80031	CR251-45P150 ETS	1		
R20	Res, car, 330k ±5%, 1/4W	376640	80031	CR251-45P330 ETS	1		
W4	Wire Assy - Brown (8800A-4403)	373738	89536	373738	1		
W5	Wire Assy - Orange/White (8800A-4-410)	391342	89536	391342	1		
W6	Wire Assy - Yellow (8800A-4406)	373761	89536	373761	1		
W7	Wire Assy - Black/White (8800A-4407)	378281	89536	378281	1		
	Battery holder (Used on BT1, BT2)	448902	89536	448902	1		
	Conn, plug/jack	170480	74970	105-752	3		
	Conn, recpt, mod 2	375329	00779	85863-3	8		
	Transipad, Xstr	152207	07047	10123-DAP	1		

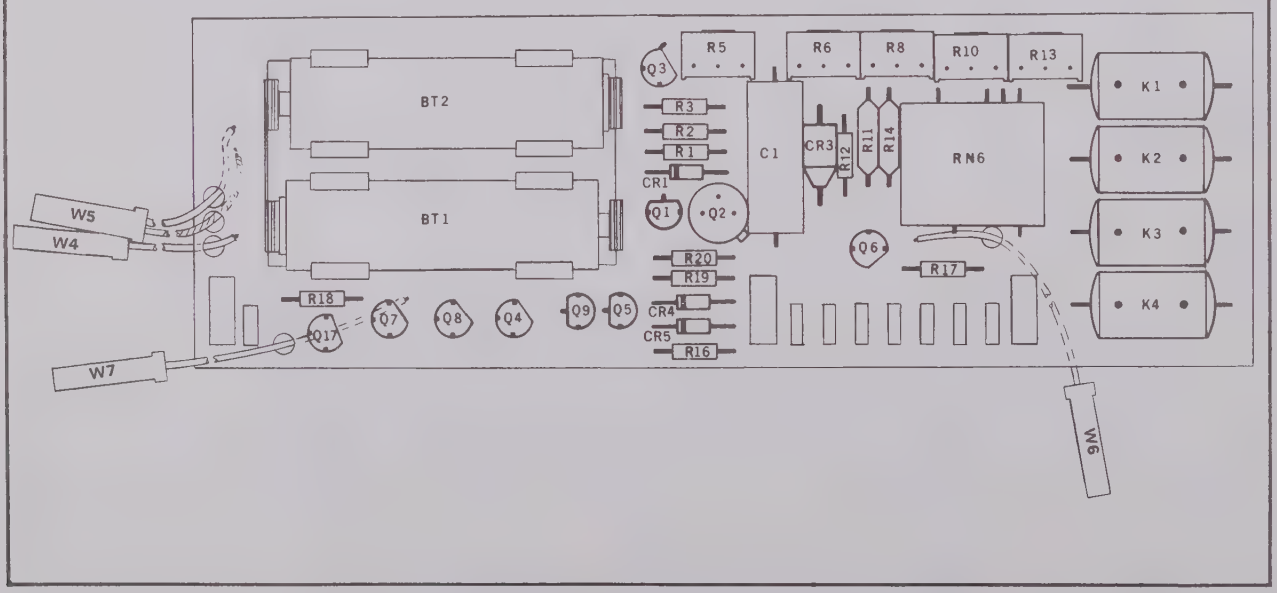

Figure 5-4. OHMS CONVERTER ASSEMBLY

Table 5-5. OHMS CONVERTER II ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A4	**OHMS CONVERTER II ASSEMBLY Figure 5-5 (8800A-4010T)**	456106	89536	456106			D
C1	Cap, polyserm, 0.022 μF ±10%, 100V	333823	01281	863UW22391	1		
C5	Cap, Ta, 100 pF ±10%, 1 kV	105593	71590	DD101	1		
C6	Cap, Ta, 10 μF ±20%, 15V	193623	56289	196D106X-0015KA1	1		
C8	Cap, mica, 33 pF ±5%, 500V	160317	72136	DM15E330J	1		
C9	Cap, mica, 12 pF ±5%, 500V	175224	72136	DM15C110J	1		
C10	Cap, cer, 0.22 μF ±20%, 50V	309849	71590	CW30C224K	1		
C11	Cap, Ta, 4.7 μF ±20%, 25V	161943	56289	196D475X-0025KA1	1		
C12	Cap, Ta, 0.22 μF ±20%, 35V	161331	56289	196D224X-0035HA1	1		
C13	Cap, cer, 0.05 μF ±20%, 100V	149161	56289	55C23A1	1		
CR2	Diode, light emitting, red	428623	12040	59NSL-5046	1	1	
CR4, CR5, CR8, CR9, CR13	Diode, Si, lo-cap, lo-leak	348177	07263	FD7223	5	1	
CR10, 12	Diode, Si, rect	453399	01295	1N4007	2	1	
K1 thru K4	Relay, dry reed, spst	357582	71707	UF-40070	4		
L1	Choke, RF	174722	72259	WEE-417	1		
R1, R29	Res, dep, car 22k ±5%, 1/4W	348870	80031	CR251-4-5P 22KT	2		
R3	Res, dep, car, 750 ±5%, 1/4W	441659	80031	CR251-4-5P-750ET	1		
R5	Res, var, cermet, 50k ±10%, 1/2W	288290	89536	288290	1	1	
R6	Res, var, cermet, 2k ±10%, 1/2W	403428	11236	362S201A	1	1	

Table 5-5. OHMS CONVERTER II ASSEMBLY (Continued)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R8	Res, var, 100 ±10%, 1/2W	326116	11236	362S101A	1	1	D
R10	Res, var, 100k ±10%, 1/2W	288308	89536	288308	1	1	
R11	Res, mf, 1M ±1%, 1/8W	268797	91637	MFF1-81004F	1		
R12, R38 thru R41	Res, dep, car, 30k ±5%, 1/4W	368753	80031	CR251-4-5P-30KT	5		
R13	Res, var, 10k ±10%, 1/2W	285171	89536	285171	1	1	
R14	Res, mf, 95.3k ±1%, 1/8W	289561	91637	MFF1-81002F	1		
R16, R17, R18	Res, dep, car, 1M ±5%, 1/4W	348987	80031	CR251-4-5P-1MT	3		
R19	Res, dep, car, 150k ±5%, 1/4W	348938	80031	CR251-4-5P-150KT	1		
R20	Res, dep, car, 330k ±5%, 1/4W	376640	80031	CR251-4-5P 330KT	1		
R25	Res, dep, car, 120k ±5%, 1/4W	441386	80031	CR251-4-5P-120KT	1		
R26	Res, comp, 470k ±5%, 2W	147710	01121	HB4745	1		
R27	Res, dep, car, 100k ±5%, 1/4W	348920	80031	CR251-4-5P-100KT	1		
R31 thru R34	Res, dep, car, 10k ±5%, 1/4W	348839	80031	CR251-4-5P-10KT	4		
R35, R37	Res, comp, 390k ±5%, 1/2W	222190	01121	EB3945	2		
R36	Res, comp, 390k ±5%, 1W	453472	01121	GB3945	1		
R42	Res, dep, car, 120 ±5%, 1/4W	442293	80031	CR251-4-5P-120ET	1		
R43, R44	Res, dep, car, 220 ±5%, 1/4W	342626	80031	CR251-4-5P-220ET	2		
RN6	Resistor Network	363796	01121	FN274	1	1	
T1	Xfmr	457168	89536	457168			
Q1, Q21	Xstr, Si, PNP	225599	12040	PN4250	2	1	
Q2, Q22, Q23	Xstr, Si, NPN	370684	04713	MPSA42	3	1	

Table 5-5. OHMS CONVERTER II ASSEMBLY (Concluded)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
Q3, Q7, Q17, Q4, Q8	Xstr, Si, NPN	261578	89536	261578	2	1	
Q5, Q9, Q24, Q25	Xstr, Si, NPN	218396	04713	2N3904	4	1	
Q6	Xstr, FET, N-channel	343830	89536	343830	1	1	
1	Conn, recpt, board mnt	375329	00779	85863-3	1		
2	Conn, jack, PCB mnt	170480	74970	105-752			
W3	Wire Assy, shielded	457077	89536	457077	1		
W4	Wire Assy, brn	373738	89536	373738	1		
W5	Wire Assy, yel.	457069	89536	457069	1		
W6	Wire Assy, blk/wht	378281	89536	378281	1		
W7	Wire Assy, orn.	457051	89536	457051	1		

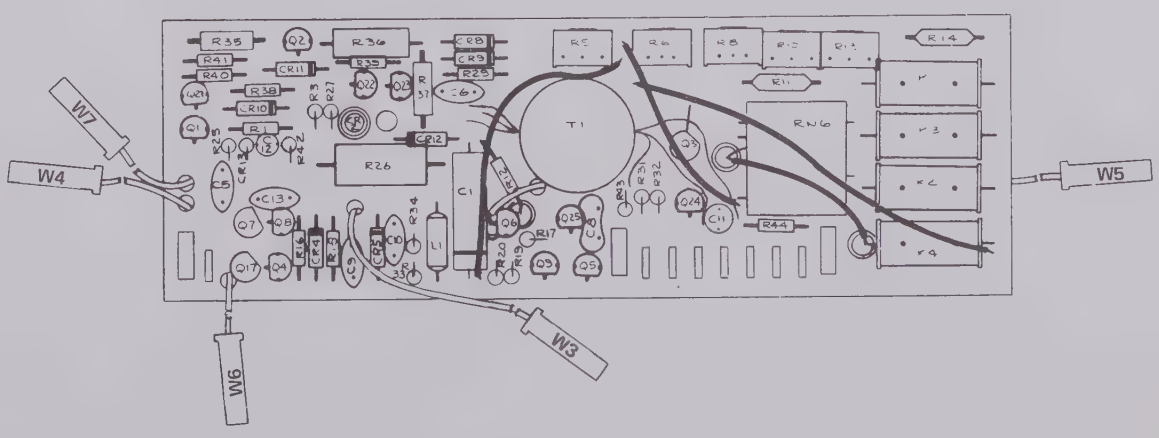

Figure 5-5. OHMS CONVERTER II ASSEMBLY

Table 5-6. AC CONVERTER PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A5	**AC CONVERTER PCB ASSEMBLY (8800A-4014 Figure 5-5)** 1	462846	89536	462846	REF		
C1	Cap, cer, 50,000 pF ±GMV, 1 kV	423004	56289	7S-12595A	1		
C2	Cap, var, teflon, trimmer, 1.5 - 0.25 pF, 100V	273151	72982	530-001	2	1	
C3	Cap, cer, 0.22 μF ±20%, 50V	309849	71590	CW30C224K	2		
C4	Cap, cer, 15 pF ±2%, 100V	369074	72982	8111-A100-C0G-150G			
C5	Cap, cer, 0.22 μF ±20%, 50V	309849	71590	CW30C224K	REF		
C6	Cap, cer, 2.2 pF ±0.25 pF, 100V	362731	72982	8101-A100-C0G-229G	1		
C7	Cap, var, teflon, trimmer, 1.5 - 0.25 pF 100V	273151	72982	530-001	REF		
C8	Cap, cer, 27 pF ±2%, 100V	362749	72982	8121-A100-C0G-270G	1		
C9	Cap, var, cer, 1.7 - 10 pF, 250V	375238	52769	GKC10000	1	1	
C10	Cap, mica, 390 pF ±1%, 500V	355339	72136	DM15F391F	1		D
C10	Cap, mica, 400 pF ±1%, 500V	385328	71236	DM15F401F	1		C
C11	Cap, poly styrene, 9, 100 pF ±2.5%, 160V	355321	71590	2DRP00J-912GAA	1		
C12	Cap, Ta, 10 μF ±20%, 15V	193623	56289	196D106X-0015KA1	1		
C13, C14	Cap, Ta, 220 μF ±20%, 6V	408682	56289	196D227X-0006TE4	3		
C15	Cap, Ta, 5.6 μF ±20%, 25V	368969	56289	196D565X-0025KA1	1		
C16, C17	Cap, plyester, film, 0.47 μF ±10%, 100V	369124	73445	C280MAH/A470K	2		
C18	Cap, Ta, 39 μF ±20%, 6V	163915	56289	196D396X-0006V	1		
C19	Cap, cer, 180 pF ±10%, 1 kV	105890	56289	BB60181KS3N	1		
C20, C21, C22	Cap, cer, 10,000 pF ±20%, 100V	149153	56289	C023B101F-103M	3		

Table 5-6. AC CONVERTER PCB ASSEMBLY (Continued)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
C23	Cap, var, cer, 5-50 pF, 250V	404301	52769	GKC50000	1	1	D
C26	Cap, Ta, 220 μF $\pm$20%, 6V	408682	56289	196D227X-0006TE4	REF		
CR1 thru CR5	Diode, si, lo-cap, lo-leak	375907	07263	FD7222	5	1	
CR6	Diode, FED, current reg	334714	07910	TCR5315	1	1	
K6, K7, K8	Relay, reed, spst	357566	71707	UF40069	3		
Q1	Xstr, Dual FET	379321	89536	379321	1	1	
Q2	Xstr, si, NPN	218396	04713	2N3904	2	1	
Q4	Xstr, si, PNP, selected	352146	89536	352146	1	1	
Q5	Xstr, si, NPN	330803	04713	MPS6560	1	1	
Q6, Q7	Xstr, FET, N-channel	343830	89536	343830	3	1	
Q8	Xstr, si, NPN	218396	04713	2N3904	REF		
Q9	Xstr, FET, N-channel	343830	89536	343830	REF		
R1	Res, mf, 2M $\pm$0.5%, 1W (red coating)	354894	89536	354894	1		
R2	Res, mf, 71.5k $\pm$1%, 1/8W	291435	91637	MFF1-87152F	1		D
R2	Res, mf, 78.7k $\pm$1%, 1/8W	289058	01637	MFF2-87872	1		C
R3	Res, mf, 158k $\pm$1%, 1/8W	237214	91637	MFF1-81583F	1		D
R3	Res, mf, 100k $\pm$1%, 1/8W	248807	91637	MFF1-81003F	1		C
R4	Res, dep, car, 240 $\pm$5%, 1/4W	376624	80031	CR251-4-5P-240ET	1		
R5	Res, mf, 498.89k $\pm$0.1%, 1/4W	357632	89536	357632	1		
R6	Res, var, cermet, 2k $\pm$10%, 1/2W	285163	89536	285163	1	1	
R7	Res, mf, 55,151 $\pm$0.1%, 1/8W	357624	89536	357624	1		
R8	Res, var, cermet, 200 $\pm$10%, 1/2W	285148	89536	285148	1	1	
R9	Res, mf, 4787.4 $\pm$0.1%, 1/8W	357616	89536	357616	1		
R10	Res, var, cermet, 20 $\pm$20%, 1/2W	285114	11236	360TS200B	1	1	
R11	Res, mf, 250 $\pm$0.1%, 1/8W	357608	91637	MFF1-82510B	2	1	
R12	Res, dep, car, 1. $\pm$5%, 1/4W	357665	80031	CR251-4-5P-1ET	1		D

Table 5-6. AC CONVERTER PCB ASSEMBLY (Continued)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R12	Res, dep, car, 0.5 ±5%, 1/4W	381954	80031	CR1-45 PO. 50ΩS	1		C
R13	Res, mf, 9.09k ±1%, 1/8W	221663	91637	MFF1-89091F	1		
R14	Res, mf, 33.2k ±1%, 1/8W	291393	91637	MFF1-83322F	1		
R15	Res, dep, car, 220 ±5%, 1/4W	342626	80031	CR251-4-5P-220ET	1		
R17	Res, mf, 250 ±0.1%, 1/8W	357608	91637	MFF1-82510B	REF		
R18	Res, dep, car, 3.3k ±5%, 1/4W	348813	80031	CR251-4-5P-3K3T	1		
R19	Res, dept, car, 10k ±5%, 1/4W	348839	80031	CR251-4-5P-10KT	1		
R20	Res, car, cermet, 50 ±10%, 1/2W	285122	89536	285122	1		
R21	Res, mf, 2194 ±0.1%, 1/8W	375345	89536	375345	1		
R22	Res, mf, 68.1k ±1%, 1/8W	236828	91637	MFF1-86812F	1		
R23	Res, dep, car, 150k ±5%, 1/4W	348938	80031	CR251-4-5P-100KT	1		
R24	Res, dep, car, 220k ±5%, 1/4W	348953	80031	CR251-4-5P-220KT	1		
R25	Res, dep, car, 47k ±5%, 1/4W	348896	80031	CR251-4-5P-47KT	1		
R26	Res, dep, car, 22 ±5%, 1/4W	381145	80031	CR251-4-5P-22ET	1		
R27	Res, dep, car, 75k ±5%, 1/4W	394130	80031	CR251-4-5P-75KT	1		
R28	Res, dep, car, 12k ±5%, 1/4W	348847	80031	CR251-4-5P-12KT	1		
R29	Res, comp, 47k ±5%, 1/4W	148163	01121	CB4735	1		
R30	Res, car, cermet, 1k ±10%, 1/2W	275750	89536	275750	1	1	D
R31	Res, mf, 48.7k ±1%, 1/8W	267385	91637	MFF1-84872F	1		D

Table 5-6. AC CONVERTER PCB ASSEMBLY (Concluded)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U1	IC, op amp	329912	12040	LM318H	1	1	
1	Conn, plug/jack, red	170480	74970	105-752	2		
2	Conn, receptacle, BD-MOD2	375329	00779	85863-3	8		
3	Heatsink, xstr	370155	05820	204-CB	1		
4	Screw, PHP, 4-40X1/4	129890	73734	19022	3		
5	Shield	406280	89536	406280	1		
6	Spacer, xstr mtg	175125	07047	10172-DAP	1		
7	Spacer, PCB, water soluble (use with R1)	334797	32559	T0-35-15	1		
8	Spacer, PCB, water soluble (use with C2, C7)	380790	32559	T0-21-10	2		
W8	Wire Assembly	373688	89536	373688	1		
1	Unless otherwise specified all parts contained in the AC converter assembly #462846 are valid for all revisions of the 8800A instruments.						
2	These parts are used on instruments with serial numbers greater or equal to 656000.						

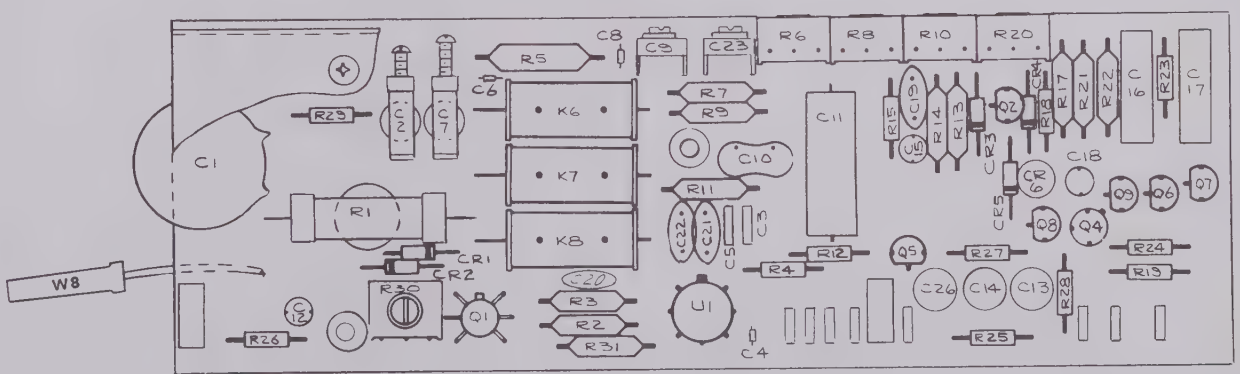

Figure 5-6. AC Converter Assembly

Table 5-7. DOU PCB

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	DOU PCB ASSEMBLY –02 Option **Figure 5-7**						
C1, C3	Cap, elect, 200 uF +50/–10%, 10V	236935	73445	ET221X010A5	2		
C2	Cap, plstc, 0.022 uF ±10%, 50V	271577	06001	75F1R5A222	1		
C4	Cap, fxd, cer, 0.05 uF +80/–10%, 25V	148924	32897	5855Y5U503Z	1		
CR1	Rectifier, bridge	296509	51605	FB100	1		
CR2	Diode, zener, 5.6V	277236	07910	1N752A	1		
Q1, Q2, Q5	Xstr, Si, NPN	218396	04713	2N3904	3		
Q3, Q4	Xstr, Si PNP	195974	04713	2N3906	2		
R15, R16	Res, car dep, 1k ±5%, 1/4W	343426	TOYO	R251025	2		
R17, R18	Res, comp, 4.7M ±5%, 1/4W	220046	01121	CB4755	2		
RN1	Res, network	385930	89536	385930	1		
T1	Xfmr, power	374652	89536	374652	1		
U1 thru U4, U10	IC, C-MOS, Dual, 4-bit Static shift register	340125	04713	MC14015CP	5		
U5	IC, C-MOS, Dual, type "D" Flip-Flop ⊗	340117	04713	MC14013CL	1		
U6	IC, COS-MOS, NOR Gates ⊗	355172	04713	MC14001CL	1		
U7, U8, U12, U13, U14	IC, C-MOS, hex, Buffer/Inverter ⊗	381848	49671	CD4049AE	5		
U9	IC, DTL, C-MOS, Quad, Bilateral SW ⊗	363838	49671	CD4016AE	1		
U11	IC, C-MOS, Dual, 4-Input, NOR Gates ⊗	363820	49671	CD4002AE	1		
U16, U17	Op to Isolator, photo Xstr	380014	86539	MCT2	2		
	Cable, flat	385922	08261	5112-007.25X	1		
	Socket, IC, 14 pin	276527	23880	TSA2900–14W	4		
	Socket, IC, 16 pin	276535	23880	TSA2900–16W	11		

⊗ Indicates MOS device that may be damaged by static dicharge.

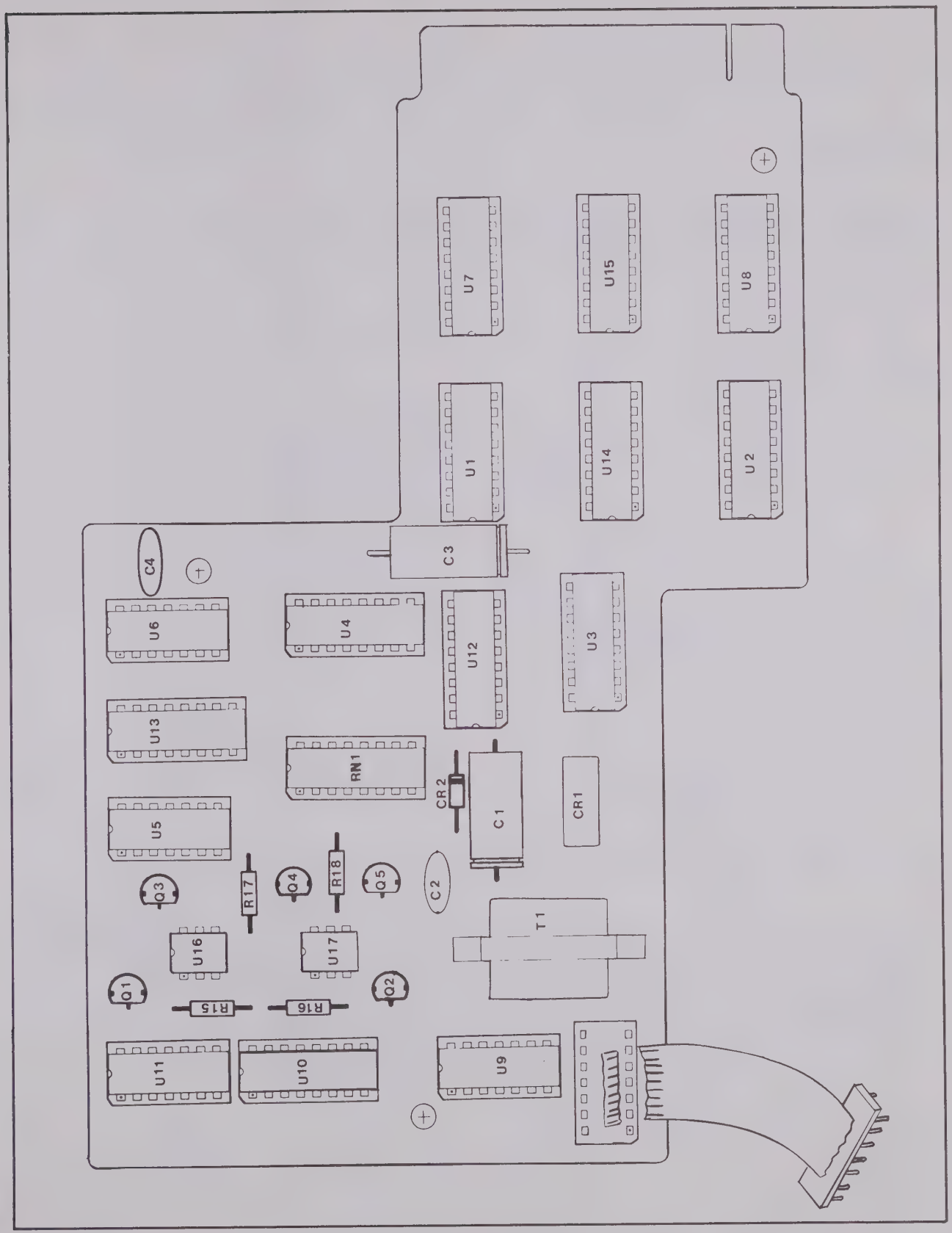

Figure 5-7. DOU PCB ASSEMBLY

Section 6
Option & Accessory Information

6-1. INTRODUCTION

6-2. This section of the manual contains information pertaining to the options and accessories available for your instrument. Each of the options and accessories are described under separate major headings containing the model or option number. The option descriptions contain applicable operating and maintenance instruction, and field installation procedures. Replaceable parts and schematics for all options are given in Sections 5 and 8, respectively.

6-3. HIGH VOLTAGE PROBE (80K40)

6-4. Introduction

6-5. The Model 80K-40 High Voltage Probe as shown in Figure 6-7, provides the 1000X attenuation necessary to extend the dc voltage measuring capabilities of the 8800A up to 40 kV dc. A schematic of the 80K-40 probe is shown in Figure 6-8.

Figure 6-1. HIGH VOLTAGE PROBE (80K-40)

6-6. Specifications

(Calibrated for 10 MΩ DVM input resistance)

Overall Accuracy:	20kV to 30kV ±2% (Calibrated 1% at 25kV)
Upper Limit:	Changes linear from 2% at 30kV to 4% at 40kV
Lower Limit:	Changes linear from 2% at 20kV to 4% at 1kV
Voltage Range:	1kV to 40kV
Input Resistance:	1000MΩ
Division Ratio:	1000:1

6-7. Operation

6-8. Use the following procedure for operating the 8800A with the 80K-40 probe:

a. Plug the 80K-40 dual-banana plug into the INPUT - Ω SENSE HI and LO terminals on the 8800A.

b. Depress the DCV pushbutton (FUNCTION)

c. Select the desired voltage range in accordance with Table 6-1.

d. Connect the common probe lead to a suitable ground and touch the probe tip to the circuit point to be measured.

e. Observe dc voltage reading displayed in kilovolts on the 8800A readout.

CAUTION

Before touching probe tip to a high voltage source, always connected probe common lead to circuit common. Removal of the probe common connection during a measurement may result in damage to the 8800A.

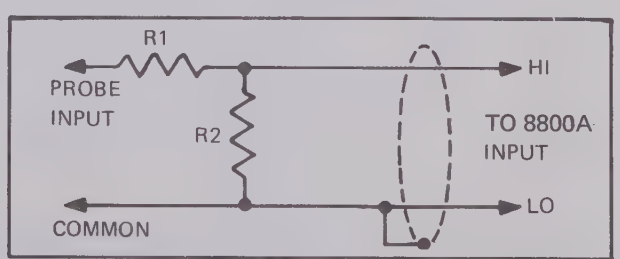

Figure 6-2. HIGH VOLTAGE PROBE, SCHEMATIC

Table 6-1. 8800A RANGES FOR DC HV PROBE (80K-40)

8800A RANGE SELECTED	8800A VOLTAGE RANGE WITH 80K-40 PROBE
200	20 to 40 kV
20	2 to 20 kV
2	1 to 2 kV

6-9. HIGH FREQUENCY PROBE (82RF)

6-10. Introduction

6-11. The Model 82RF High Frequency Probe, Figure 6-9, extends the frequency range of the 8800A to include 100 kHz to 500 MHz for ac voltage measurements from 0.25 to 30V rms. The 82RF operates in conjunction with the dc voltage ranges, and is connected to the 8800A using a shielded dual-banana plug and an adapter.

6-12. Specifications

Voltage: 0.25V to 30V rms, 200 Vdc Max

Freq Response: 100 kHz to 200 MHz; ±1 dB, 200 MHz to 500 MHz; ±3 dB

Extended Response: 20 kHz to 1 BHz (useful for relative readings)

AC to DC Transfer Accuracy: Loaded with 10 megohms ±10%.

	100 kHz– 100 MHz	100 MHz– 500 MHz
+10°C to +30°C	+5%	+7%
–10°C to +40°C	+7%	+15%

< ±3 db at 10 kHz and 700 MHz

Input Impedance: 2 MΩ shunted by 4 pF

Maximum Input Voltage: 30 volts rms ac, 200 volts dc

Cable Connections: Shielded dual banana plug fits all standard ¾-inch dual banana connectors.

Cable Length: 4 ft. (121.9 cm) minimum

Weight: 3½ oz. net

Accessories: Ground lead, straight tip, hook tip, high frequency adapter.

6-13. Operating Notes

6-14. The straight and the hooked tips supplied with the probe are useful for making voltage measurements up to 100 MHz. For measurements above 100 MHz use the high frequency adapter tip with mating connector and 50 ohm terminations.

6-15. The maximum input to the probe is 30V rms or 200V dc. These voltage limits may be used in combination so that the ac component of an ac signal superimposed on dc level can be measured.

CAUTION

Changing the dc level of the input signal by more than 200 volts will damage the probe.

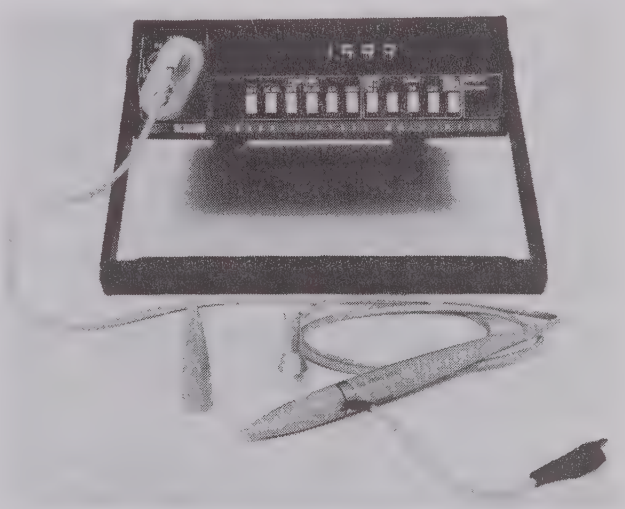

Figure 6-3. 82RF, HIGH FREQUENCY PROBE

6-16. Operation

6-17. Use the following procedure for operating the 8800A with the 82RF probe:

a. Connect the 80RF-1 shielded dual-banana plug to the 8800A V-Ω and COMMON INPUT terminals.

b. Attach the desired probe tip to the probe body.

c. Depress the DCV pushbutton (FUNCTION)

d. Select the desired voltage range.

e. Connect the probe's ground lead to a suitable ground when using the straight or hooked probe tip. The ground clip is not required when using the high frequency adapter with an appropriate 50 ohm termination.

f. Touch the probe tip to the circuit point to be measured.

g. Observe the voltage reading displayed in volts rms on the 8800A readout.

6-18. Theory of Operation

6-19. A schematic diagram of the 82RF High Frequency probe is given in Figure 6-4. Capacitor C1 is used as a dc blocking capacitor, diode CR1 is used as a detector, and resistors R1, R2, R3 and R_{in} form a divider network. During the negative half cycle of the ac input voltage, C1 charges through CR1 to the negative peak value of the input signal. This negative charge path provides the zero reference for the dc output signal. During the positive half cycle of the input signal the charge on C1 is added to the peak value of the positive input to produce a positive peak-peak voltage at the junction of C1 and CR1. The divider network scales this voltage to provide a dc output voltage which is equal to the rms value of the input signal.

6-20. Diode CR2 compensates for the non-linearity of the detector, and R3 is a selected part having a value of 50 kΩ to 100 kΩ.

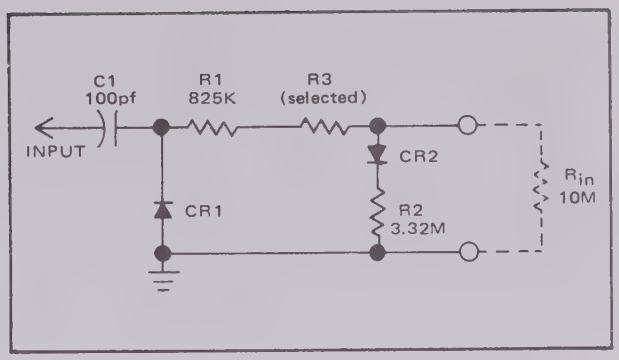

Figure 6-4. 82RF SCHEMATIC

6-21. Maintenance

6-22. PERFORMANCE TEST

6-23. The low and high frequency tests given below are used to verify the ac-to-dc transfer accuracy of the 82RF High Frequency Probe.

6-24. Low Frequency Response

6-25. Connect equipment as shown in Figure 6-5, and perform the following steps.

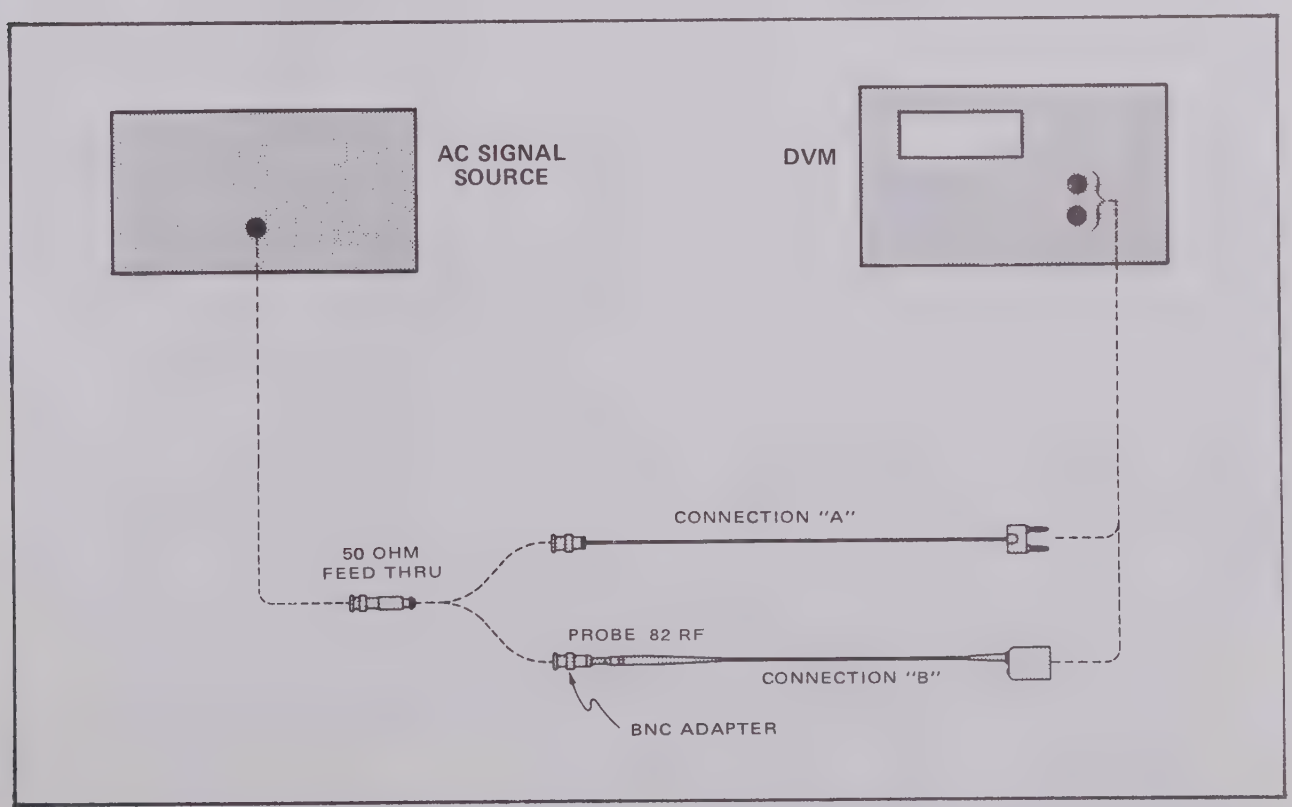

Figure 6-5. LOW FREQUENCY RESPONSE CHECK

a. With equipment as shown in connection "A" adjust the ac signal source for an output of 3.000V rms at 100 kHz as measured on the DVM.

b. In connection "B" with the DVM set to measure V dc, observe a probe output of 3.15 to 2.85V dc.

c. Placing cables back in connection "A", decrease the ac signal source by 10 db (0.95V rms).

d. Moving back to connection "B", observe a voltmeter indication of between 1.00 and 0.90V dc (10 db down from 3.0V dc).

e. In connection "A", decrease the ac signal source an additional 10 db (to 0.3V rms) as indicated by the voltmeter in its ac function.

f. Back to "B", observe a voltmeter reading of .315 to .285V dc.

g. Return the ac signal source back to 3.000V rms.

h. Repeat steps a through g with frequencies of 500 kHz, 1 MHz, and 10 MHz.

6-26. High Frequency Response

6-27. Connect equipment to the 82RF probe as shown in Figure 6-6, and perform the following steps:

a. Set the ac signal source to 100 MHz with an output level of 10 milliwatts as indicated on the power meter. Ensure that the ac signal source has stabilized at the 10 milliwatt output.

b. Observe that the voltmeter indication is between 0.757 and 0.657V dc, (0.707V dc corresponds to 10 milliwatts into 50 ohms.)

c. Repeat the above for frequencies of 200 MHz, 300 MHz, 400 MHz, and 480 MHz.

6-28. CALIBRATION

6-29. Should the 82RF require recalibration, perform the following steps:

a. Perform steps a and b in paragraph 6-44, with a frequency of 1 MHz.

b. Observe the dc voltmeter; a reading below 3V dc calls for a decrease in the value of R3, a reading above 3V dc calls for an increase in R3. Resistor R3 should be a 1/8W metal film type. In a probe that is working properly, a 30 kΩ change in R3 will produce about a 1% deviation in the reading.

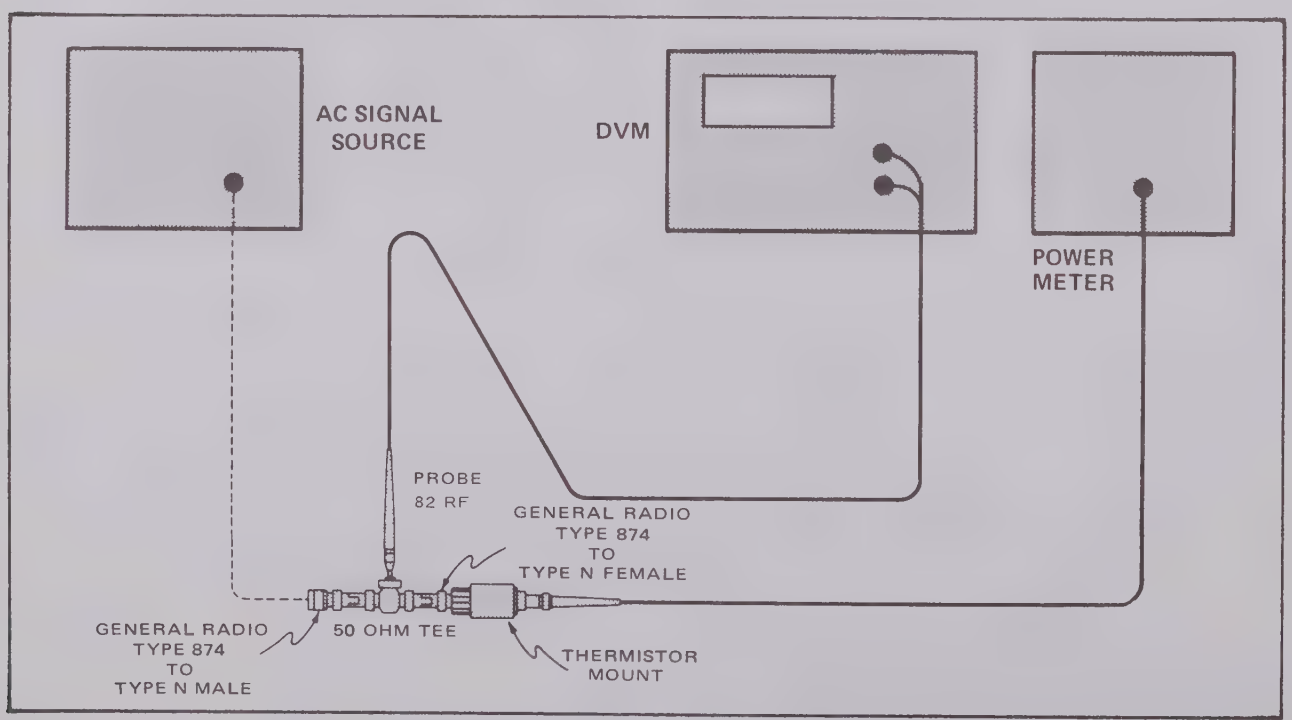

Figure 6-6. HIGH FREQUENCY RESPONSE CHECK

6-30. HIGH FREQUENCY PROBE (81RF)

6-31. Introduction

6-32. The Model 81RF High Frequency Probe, Figure 6-7, extends the frequency range of the 8800A to include 100 kHz to 100 MHz for ac voltage measurements from 0.25 to 30V rms. The 81RF operates in conjunction with the dc voltage range, and is connected to the 8800A using a shielded dual-banana plug and an adapter.

6-33. Specifications

Extended Response:	20 kHz to 250 MHz (useful for relative readings)
Transfer Accuracy:	±1 dB from 100 kHz to 100 MHz
Input Voltage Range:	0.25V rms to 30V rms (operated into a 10 MΩ input resistance voltmeter). Peak responding calibrated to read rms value of a sinewave.
Maximum DC Input:	350V
Input Impedance:	12MΩ shunted by ≈ 15 pf maximum

6-34. Operation

6-35. Use the following procedure for operating the 8800A with the 81RF probe.

a. Connect the 81RF shielded dual-banana plug to the 8800A INPUT · Ω SENSE HI and LO terminals.

b. Attach the desired probe tip to the probe body.

c. Depress the DCV pushbutton (FUNCTION)

d. Select the desired voltage range.

e. Connect the probe's ground lead to a suitable ground.

f. Touch the probe tip to the circuit point to be measured.

g. Observe the voltage reading displayed in volts rms on the 8800A readout.

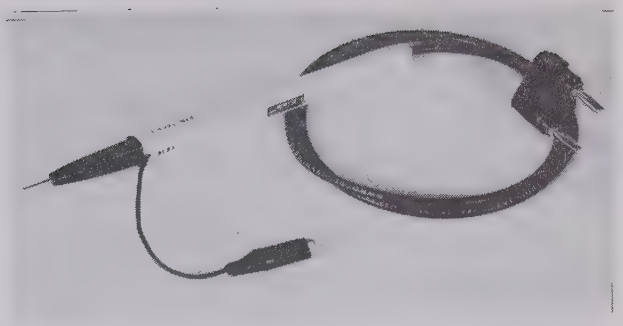

Figure 6-7. HIGH FREQUENCY PROBE (81RF)

6-36. TEMPERATURE PROBE (80T-150)

6-37. Introduction

6-38. The Model 80T-150 Temperature Probe is a self-contained temperature-to-voltage converter. It is designed to provide a direct temperature reading on the display of any high impedance voltmeter (>1 MΩ) capable of 1 mV resolution, and at least 300 full-scale readout. The probe can be configured to provide either one of two temperature displays; —50 to +150°C or —58 to +300°F.

6-39. Operating power for the probe is provided by an internal lithium battery. Typically, the battery will provide up to 1000 hours of continuous operation before replacement is necessary. An ON/OFF switch is provided to conserve the battery when the probe is not in use.

6-40. Operating Notes

6-41. PROBE LIMITATIONS

6-42. The 80T-150 probe is constructed of highly durable plastic and is suitable for measuring the temperature of liquids, gases and solids up to 150°C. When making the temperature measurements, observe the following precautions to prevent damage to the probe:

1. Do not expose the probe end (probe tip plus 2 inches of probe body) to temperatures in excess of +150°C. The remainder of the probe body should not be exposed to temperatures above +70°C.
2. Most corrosive agents will not damage the probe body. However, the aluminum probe tip will deteriorate under long term exposure to corrosive environments.

CAUTION

Long term exposure of the probe to corrosive environments will result in pitting and deterioration of the aluminum probe tip.

6-43. MEASUREMENT ERROR SOURCES

6-44. Techniques used when making the temperature mesurements can affect the accuracy of the reading. The following information will aid in making more accurate temperature measurements.

1. When the probe tip is applied to a solid surface it draws or sinks heat from the surface. Therefore, if the measured surface has a low mass (e.g., a transistor case), the indicated temperature may be lower than the actual temperature.

2. Similarly, a steady-state error or gradient exists between the mesured surface and the sensing device in the probe tip. This is due to the flow of heat from the measurement surface to the probe body. The effect of the steady-state error increases as the differential between ambient and surface temperature increases.

3. To determine the actual surface temperature of a device, both the heat-sinking and steady-state errors must be considered. The correction curve given in Figure 6-9 approximates the effect of both error sources on TO-3, TO-5 and TO-18 transistor cases.

4. RF signals applied to the 80T-150 probe tip can also cause errors in tempeature measurement. Figure 6-10 defines the rf signal limits that can be tolerated without degrading measurement accuracy.

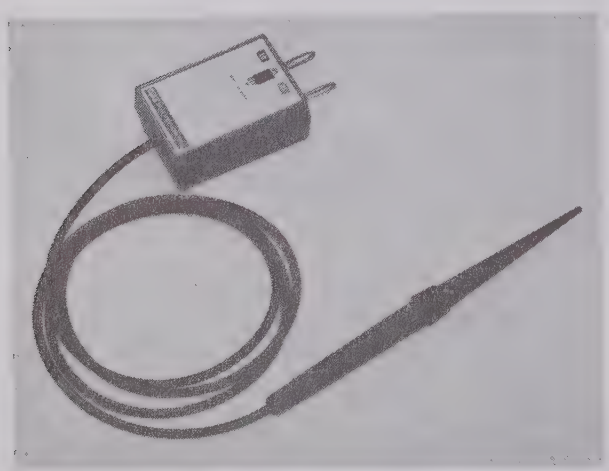

Figure 6-8. TEMPERATURE PROBE (80T-150)

6-45. Operating Instructions

6-46. The following instructions should be adhered to in order to obtain the best results from the 80T-150 probe.

1. Connect the banana plugs on the 80T-150 to the V-Ω and COMMON input terminals. Observe polarity.

2. Select the 200 mV range on the 8800A.

3. Set the 80T-150 power switch to the ON position and energize the 8800A.

4. Firmly touch the probe tip to the surrace to be measured, or expose it to the gas or liquid. The 8800A will display the temperature in degrees. Vary the probe angle and pressure when measuring solid surface temperatures; the highest stable reading will be the most accurate.

NOTE

The 8800A will display the temperature in degrees Celsius or Fahrenheit determined by the type of probe used' (See back of probe case)

CAUTION

The force exerted on the probe tip should not exceed 20 pounds.

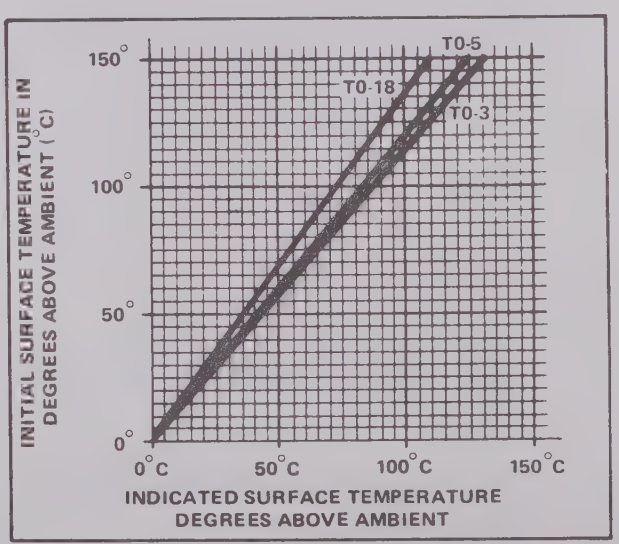

Figure 6-9 INITIAL CASE TEMPERATURE ABOVE AMBIENT vs. METER READING ABOVE AMBIENT

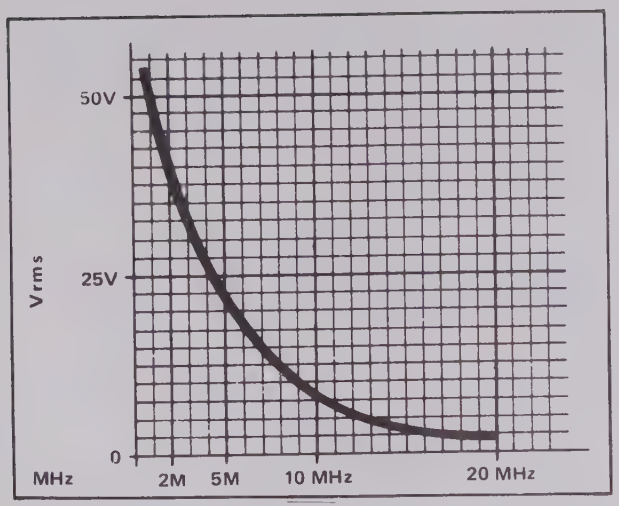

Figure 6-10. MAXIMUM RF SIGNAL LIMITS (V RMS) AT PROBE TIP

6-47. RACK MOUNT KIT

6-48. Introduction

6-49. A rack mounting kit is available for mounting the 8800A in a standard 19-inch equipment rack. The rack mounting kit positions the 8800A in the center of the equipment rack.

6-50. Installation Procedure

6-51. Installation instructions for the rack mounting kit are presented below. Refer to Figure 6-11 while performing the steps of the mounting procedure.

a. Remove the handle disc decal and handle; retain the handle mounting screws.

b. Remove the instrument retaining screws (rear of the case) and remove the instrument from the case.

c. Insert the open end of the instrument case into the center rack mount plate until the case is flush with the front surface of the plate. Fasten the rack mount brackets and retainers to the case as shown.

d. Secure the brackets and retainers to the handle mounting bosses using the handle mounting screws. Take care to avoid stripping the threads.

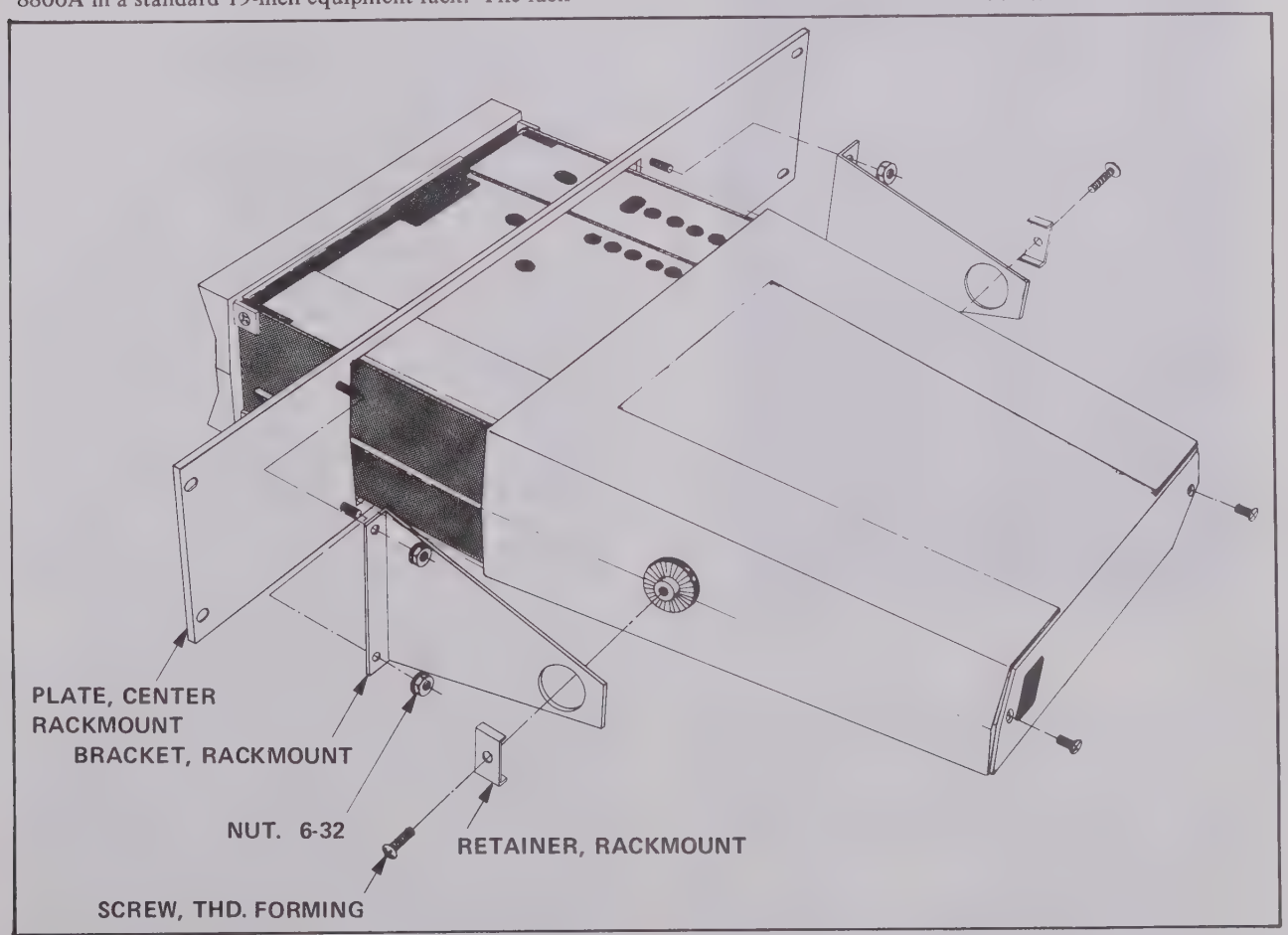

Figure 6-11. RACKMOUNT INSTALLATION

e. Position the instrument case on the center rack mount plate and fasten the brackets using the 6-32 nuts.

f. Re-install the instrument in the case and replace the instrument retaining screw.

6-52. DELUXE TEST LEAD KIT (A80)

6-53. The deluxe test lead kit, shown in Figure 6-12, contains two test leads with probes (red and black), and five pairs of universal probe tips. The probe tips include: alligator clips, test prod tips, pin tips, banana plug tips, and binding post lugs. A convenient plastic pouch is provided for storing the contents of the test lead kit.

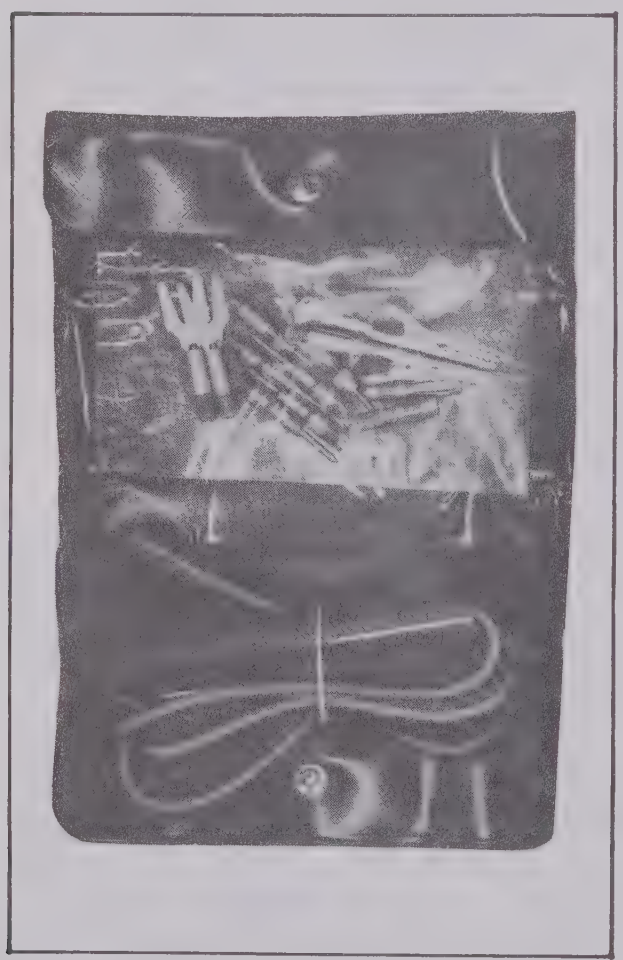

Figure 6-12. DELUXE TEST LEAD KIT (A80)

6-54. DATA OUTPUT UNIT (Option –02)

6-55. Introduction

6-56. The Data Output Unit (DOU) provides digital measurement information to a rear panel output connector for use by remote display instruments or data printers. The output data is in parallel bcd format and is compatible with the Fluke Model 2010A Digital Printer.

6-57. Specifications

6-58. The specifications for the DOU are presented in Section 1 of this manual.

6-59. Operation

6-60. DOU DATA IDENTIFICATION

6-61. The data available at the rear panel DOU connector is listed in Table 6-2. The connector pin assignment and logic level requirement for each signal is provided.

6-62. DATA UPDATE

6-63. Refer to DOU Schematic, Section –8 and the timing diagram (Figure 6-13) for the following discussion. The DOU output can be updated by an external command (ARM ENABLE, ARM INPUT) or allowed to update automatically (FREE RUN) at the end of each new instrument measurement. A logic level 1 (+4.75 to +5.25V) applied to ARM ENABLE (pin B) and a logic level 0 applied to FREE FUN will prevent acquisition of new data by the DOU. A positive going trigger applied to ARM INPUT (pin C) will eanble the DOU to acquire data. New data will start to load into the DOU after the next measurement is complete. BZ (from the instrument to the DOU) occurs synchronously with the second ST0 signal after a measurement is complete and lasts for one strobe cycle. BZ is presented to U10 as a data input. ST5 clocks the data into U10. As soon as data appears in U10, RG is applied through U11 and the isolation circuit to U4, U3, U2, and U1. At this time the busy flags are applied to the DOU output signifying that data is being changed. U10 enables the data on W to be serially loaded into the bottom of U4 during the first strobe cycle. When ST5 occurs again, the data in U10 is shifted to enable the data on X to be loaded into U4. Four strobe cycles are required to load the new data. When the fifth ST5 signal occurs, U10 is empted of data and all its outputs are 0. RG is then inhibited by U11 and the clocking of data ceases. The busy flags are cleared from the DOU output and the data can be read. ARM INPUT may go to 0 at any time in the cycle but it must go to 0 before a data update can be externally commanded. If desired the DOU will automatically update at the end of each instrument measurement. If FREE RUN is allowed to be high, the DOU will automatically update the data after each measurement.

Table 6-2. DOU DATA IDENTIFICATION

DOU DATA NAME	DOU PIN NO.		DOU DATA NAME	REMARKS
+5V	1	A	LOGIC RETURN	
BUSY FLAG	2	B	ARM ENABLE	
POL FLAG	3	C	ARM INPUT	
$\overline{\text{BUSY}}$ FLAG	4	D	FREE RUN	
(8800A) $\overline{\text{POL}}$ FLAG	5	E	NOT USED	
OVERLOAD Ω	6	F	a RANGE CODE	
RANGE CODE b	7	H	c RANGE CODE	
W6	8	J	X6 } 4 BITS	
Y6	9	K	Z6 } LSD (8800A)	
W5	10	L	X5 } 4 BITS	
Y5	11	M	Z5 } LSD (8600A)	
W4	12	N	X4 } 4 BITS	
Y4	13	P	Z4 } 4SD	
W3	14	R	X3 } 4 BITS	
Y3	15	S	Z3 } 3SD	
W2	16	T	X2 } 4 BITS	
Y2	17	U	Z2 } 2SD	
(GND) W1	18	V	X1 (GND) } 4 BITS MSD	
(GND) Y1	19	W	Z1 } ONE ACTIVE	
	20	X	NOT USED	
	21	Y	NOT USED	
NOT USED	22	Z	NOT USED	

BCD BIT WEIGHT
W = 8
X = 4
Y = 2
Z = 1

RANGE	CODE		
	a	b	c
200Ω	0	0	1
2K	0	1	0
20K	0	1	1
200K	1	0	0
2000K	1	0	1
20MΩ	1	1	0

6-64. BUSY FLAG

6-65. The updating period of the DOU is signified by the BUSY (pin 2) and BUSY (pin 4) outputs from the DOU. During this period the data on the output connector pins will be changing to reflect the updated input. Either the positive true BUSY or negative true BUSY flag can be used to inhibit the data recording instrument during this time period.

6-66. POLARITY FLAG

6-67. The polarity of the dc voltage input to the A-D Converter determines which polarity sign will be presented at DOU output pin 3; pin 5 provides POL in Model 8800A only. A positive dc level at the converter will cause DOU output pin 3 to go to logic 1 and pin 5 (8800A) to go to logic 0. A negative converter input will cause the opposite logic level output from each pin.

6-68. OVERLOAD INDICATION

6-69. The DOU provides a single-bit output indication of a display overload condition. When the digit count exceeds the display capacity pin 6 of the DOU output connector changes from a logic 0 to logic 1.

6-70. RANGE CODE

6-71. The instrument range is presented in a three-bit bcd format at DOU output connector pins H, 7, and F. The output code representing each range is presented in Table 6-2.

6-72. DISPLAY DIGIT

6-73. The numerical value of each digit of the instrument display is presented in a four-bit bcd format at the DOU output connector. The connector pin assignments for each significant digit of the display are provided in Table 6-2. The most significant digit (DOU connector pins 18, 19, V, and W) needs only one active bit to represent the two display digits, 1 or 0. The three remaining bits are connected to ground in the DOU and, in most cases, the corresponding bits in the remote display unit must also be grounded to represent a logic 0.

6-74. DOU INTERFACE CABLE

6-75. A mating DOU connector is supplied with the DOU option for fabrication of a custom interface cable. Use the following procedure when constructing the interface cable

a. Assemble the following equipment:

1. Teflon or vinyl insulated wire, 26 gauge, 31 pieces cut to the desired length.
2. Sleeving, # 16 for vinyl wire, or # 18 for teflon.
3. Rosin core solder, 60/40.
4. Wire strippers.
5. Soldering iron, pencil-type (45 W max.)
6. DOU mating connector.
7. Mating connector for interface instrument.

b. Strip one-half inch of insulation from the DOU connector end of the wires and tin each wire.

c. Cut 31 pieces of sleeving one-half inch long.

d. Place one piece of sleeving over each prepared wire.

e. Solder a connector contact pin to each wire.

f. Slide the sleeving over each solder connection.

g. Insert one connector contact pin into each DOU mating connector position corresponding to the desired data output.

h. Prepare the mating connector for the interface instrument. Ensure that the data line connections, at the interface instrument mating connector, place the DOU data on the correct pins.

6-76. Theory of Operation

6-77. The DOU receives four lines (W, X, Y, and Z) or data, in character serial format, from the instrument; each line containing eight bits of data. The data lines are sequentially gated, by four successive strobe 5 signals, across an isolation circuit to a series of shift registers. The data from the shift registers is applied through inverting amplifiers to the DOU output connector. A schematic of the DOU circuitry is provided in Figure 8-7.

6-78. The external trigger synchronizing circuit produces an enabling signal that allows the shift registers to accept new data. When a logic 1 is applied to the DOU connector pin D (FREE RUN) the sync circuit will enable the shift registers to update the data with each new input from the instrument. By applying a logic 0 to pin D and a logic 1 to pin B (ARM ENABLE), a positive trigger at pin C (ARM INPUT) will cause the sync circuit to enable the shift registers for the first complete data input that occurs after the arm-input-trigger.

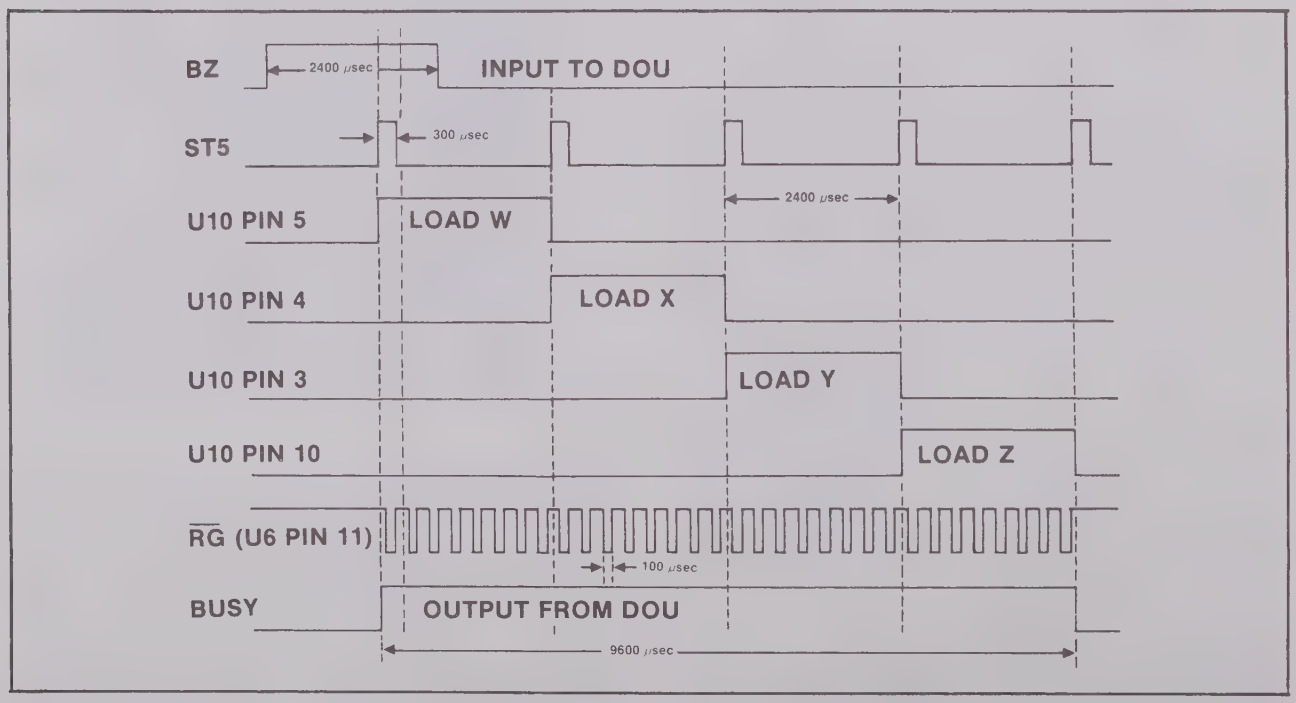

Figure 6-13. DOU TIMING DIAGRAM

Section 7

General Information

7-1. This section of the manual contains generalized user information as well as supplemental information to the List of Replaceable parts contained in Section 5. The following information is presented in this section:

List of Abbreviations
Federal Supply Codes for Manufacturers
Fluke Technical Service Centers — U.S. and Canada
Sales and Service Locations — International
Sales Representatives — U.S. and Canada

A or amp	ampere
ac	alternating current
af	audio frequency
a/d	analog-to-digital
assy	assembly
AWG	american wire gauge
B	bel
bcd	binary coded decimal
^{o}C	Celsius
cap	capacitor
ccw	counterclockwise
cer	ceramic
cermet	ceramic to metal(seal)
ckt	circuit
cm	centimeter
cmrr	common mode rejection ratio
comp	composition
cont	continue
crt	cathode-ray tube
cw	clockwise
d/a	digital-to-analog
dac	digital-to-analog converter
dB	decibel
dc	direct current
dmm	digital multimeter
dvm	digital voltmeter
elect	electrolytic
ext	external
F	farad
^{o}F	Fahrenheit
FET	Field-effect transistor
ff	flip-flop
freq	frequency
FSN	federal stock number
g	gram
G	giga (10^{9})
gd	guard
Ge	germanium
GHz	gigahertz
gmv	guaranteed minimum value
gnd	ground
H	henry
hd	heavy duty
hf	high frequency
Hz	hertz
IC	integrated circuit
if	intermediate frequency
in	inch(es)
intl	internal
I/O	input/output
k	kilo (10^{3})
kHz	kilohertz
kΩ	kilohm(s)
kV	kilovolt(s)
lf	low frequency
LED	light-emitting diode
LSB	least significant bit
LSD	least significant digit
M	mega (10^{6})
m	milli (10^{-3})
mA	milliampere(s)
max	maximum
mf	metal film
MHz	megahertz
min	minimum
mm	millimeter
ms	millisecond
MSB	most significant bit
MSD	most significant digit
MTBF	mean time between failures
MTTR	mean time to repair
mV	millivolt(s)
mv	multivibrator
MΩ	megohm(s)
n	nano (10^{-9})
na	not applicable
NC	normally closed
(–) or neg	negative
NO	normally open
ns	nanosecond
opnl ampl	operational amplifier
p	pico (10^{-12})
para	paragraph
pcb	printed circuit board
pF	picofarad
pn	part number
(+) or pos	positive
pot	potentiometer
p-p	peak-to-peak
ppm	parts per million
PROM	programmable read-only memory
psi	pound-force per square inch
RAM	random-access memory
rf	radio frequency
rms	root mean square
ROM	read-only memory
s or sec	second (time)
scope	oscilloscope
SH	shield
Si	silicon
serno	serial number
sr	shift register
Ta	tantalum
tb	terminal board
tc	temperature coefficient or temperature compensating
tcxo	temperature compensated crystal oscillator
tp	test point
u or μ	micro (10^{-6})
uhf	ultra high frequency
us or μs	microsecond(s) (10^{-6})
uut	unit under test
V	volt
v	voltage
var	variable
vco	voltage controlled oscillator
vhf	very high frequency
vlf	very low frequency
W	watt(s)
ww	wire wound
xfmr	transformer
xstr	transistor
xtal	crystal
xtlo	crystal oscillator
Ω	ohm(s)
μ	micro (10^{-6})

00213
Nytronics Comp. Group Inc.
Subsidiary of Nytronics Inc.
Formerly Sage Electronics
Rochester, New York

00327
Welwyn International, Inc.
Westlake, Ohio

00656
Aerovox Corp.
New Bedford, Massachusetts

00686
Film Capacitors, Inc.
Passaic, New Jersey

00779
AMP Inc.
Harrisberg, Pennsylvania

01121
Allen-Bradley Co.
Milwaukee, Wisconsin

01281
TRW Electronic Comp.
Semiconductor Operations
Lawndale, California

01295
Texas Instruments, Inc.
Semiconductor Group
Dallas, Texas

01537
Motorola Communications &
Electronics Inc.
Franklin Park, Illinois

01686
RCL Electronics Inc.
Manchester, New Hampshire

01730
Replaced by 73586

01884 - use 56289
Sprague Electric Co.
Dearborn Electronic Div.
Lockwood, Florida

02114
Ferroxcube Corp.
Saugerties, New York

02131
General Instrument Corp.
Harris ASW Div.
Westwood, Maine

02395
Rason Mfg. Co.
Brooklyn, New York

02533
Snelgrove, C.R. Co., Ltd.
Don Mills, Ontario, Canada
M3B 1M2

02606
Fenwal Labs
Div. of Travenal Labs.
Morton Grove, Illinois

02660
Bunker Ramo Corp., Conn Div.
Formerly Amphenol-Borg
Electric Corp.
Broadview, Illinois

02799
Areo Capacitors, Inc.
Chatsworth, California

03508
General Electric Co.
Semiconductor Products
Syracuse, New York

03614
Replaced by 71400

03651
Replaced by 44655

03797
Eldema Div.
Genisco Technology Corp.
Compton, California

03877
Transistron Electronic Corp.
Wakefield, Massachusetts

03888
KDI Pyrofilm Corp.
Whippany, New Jersey

03911
Clairex Electronics Div.
Clairex Corp.
Mt. Vernon, New York

03980
Muirhead Inc.
Mountainside, New Jersey

04009
Arrow Hart Inc.
Hartford, Connecticut

04062
Replaced by 72136

04202
Replaced by 81312

04217
Essex International Inc.
Wire & Cable Div.
Anaheim, California

04221
Aemco, Div. of
Midtex Inc.
Mankato, Minnesota

04222
AVX Ceramics Div.
AVX Corp.
Myrtle Beach, Florida

04423
Telonic Industries
Laguna Beach, California

04645
Replaced by 75376

04713
Motorola Inc. Semiconductor
Products
Phoenix, Arizona

04946
Standard Wire & Cable
Los Angeles, California

05082
Replaced by 94988

05236
Jonathan Mfg. Co.
Fullerton, California

05245
Components Corp. now
Corcom, Inc.
Chicago, Illinois

05277
Westinghouse Electric Corp.
Semiconductor Div.
Youngwood, Pennsylvania

05278
Replaced by 43543

05279
Southwest Machine &
Plastic Co.
Glendora, California

05397
Union Carbide Corp.
Materials Systems Div.
New York, New York

05571 - use 56289
Sprague Electric Co.
Pacific Div.
Los Angeles, California

05574
Viking Industries
Chatsworth, California

05704
Replaced by 16258

05820
Wakefield Engineering Inc.
Wakefield, Massachusetts

06001
General Electric Co.
Electronic Capacitor &
Battery Products Dept.
Columbia, South Carolina

06136
Replaced by 63743

06383
Panduit Corp.
Tinley Park, Illinois

06473
Bunker Ramo Corp.
Amphenol SAMS Div.
Chatsworth, California

06555
Beede Electrical Instrument Co.
Penacook, New Hampshire

06739
Electron Corp.
Littleton, Colorado

06743
Clevite Corp.
Cleveland, Ohio

06751
Components, Inc. Semcor Div.
Phoenix, Arizona

06860
Gould Automotive Div.
City of Industry, California

06961
Vernitron Corp., Piezo
Electric Div.
Formerly Clevite Corp., Piezo
Electric Div.
Bedford, Ohio

06980
Eimac Div.
Varian Associates
San Carlos, California

07047
Ross Milton, Co., The
South Hampton, Pennsylvania

07115
Replaced by 14674

07138
Westinghouse Electric Corp.,
Electronic Tube Division
Horsehead, New York

07233
TRW Electronic Components
Cinch Graphic
City of Industry, California

07256
Silicon Transistor Corp.
Div. of BBF Group Inc.
Chelmsford, MA

07261
Aumet Corp.
Culver City, California

07263
Fairchild Semiconductor
Div. of Fairchild Camera
& Instrument Corp.
Mountain View, California

07344
Bircher Co., Inc.
Rochester, New York

07597
Burndy Corp.
Tape/Cable Div.
Rochester, New York

07792
Lerma Engineering Corp.
Northampton, Massachusetts

07910
Teledyne Semiconductor
Formerly Continental Device
Hawthorne, California

07933 - use 49956
Raytheon Co.
Semiconductor Div. HQ
Mountain View, California

08225
Industro Transistor Corp.
Long Island City, New York

08261
Spectra Strip Corp.
Garden Grove, California

08530
Reliance Mica Corp.
Brooklyn, New York

08806
General Electric Co.
Miniature Lamp Products Dept.
Cleveland, Ohio

08863
Nylomatic Corp.
Norrisville, Pennsylvania

08988 - use 53085
Skottie Electronics Inc.
Archbald, Pennsylvania

09214
G.E. Co. Semi-Conductor
Products Dept.
Power Semi-Conductor
Products OPN Sec.
Auburn, New York

09353
C and K Components
Watertown, Massachusetts

09423
Scientific Components, Inc.
Santa Barbara, California

09922
Burndy Corp.
Norwalk, Connecticut

09969
Dale Electronics Inc.
Yankton, S. Dakota

10059
Barker Engineering Corp.
Formerly Amerace, Amerace
ESNA Corp.
Kenilworth, New Jersey

11236
CTS of Berne
Berne, Indiana

11237
CTS Keene Inc.
Paso Robles, California

11358
CBS Electronic Div.
Columbia Broadcasting System
Newburyport, MN

11403
Best Products Co.
Chicago, Illinois

11503
Keystone Columbia Inc.
Warren, Michigan

11532
Teledyne Relays
Hawthorne, California

11711
General Instrument Corp
Rectifier Division
Hickville, New York

11726
Qualidyne Corp.
Santa Clara, California

12014
Chicago Rivet & Machine Co.
Bellwood, Illinois

12040
National Semiconductor Corp.
Danburry, Connecticut

12060
Diodes, Inc.
Chatsworth, California

12136
Philadelphia Handle Co.
Camden, New Jersey

12300
Potter-Brumfield Division
AMF Canada LTD.
Guelph, Onatrio, Canada

12323
Presin Co., Inc.
Shelton, Connecticut

12327
Freeway Corp. formerly
Freeway Washer & Stamping Co.
Cleveland, Ohio

12443
Budd Co. The, Polychem Products
Plastic Products Div.
Bridgeport, PA

12615
U.S. Terminals Inc.
Cincinnati, Ohio

12617
Hamlin Inc.
Lake Mills, Wisconsin

12697
Clarostat Mfg. Co.
Dover, New Hampshire

12749
James Electronics
Chicago, Illinois

12856
Micrometals
Sierra Madre, California

12954
Dickson Electronics Corp.
Scottsdale, Arizona

12969
Unitrode Corp.
Watertown, Massachusetts

13103
Thermalloy Co., Inc.
Dallas, Texas

13327
Solitron Devices Inc.
Tappan, New York

13511
Amphenol Cadre Div.
Bunker-Ramo Corp.
Los Gatos, California

13606 - use 56289
Sprague Electric Co.
Transistor Div.
Concord, New Hampshire

13839
Replaced by 23732

14099
Semtech Corp.
Newbury Park, California

14140
Edison Electronic Div.
Mc Gray-Edison Co.
Manchester, New Hampshire

14193
Cal-R-Inc. formerly
California Resistor, Corp.
Santa Monica, California

14298
American Components, Inc.
an Insilco Co.
Conshohocken, Pennsylvania

14655
Cornell-Dublier Electronics
Division of Federal Pacific
Electric Co. Govt. Control Dept.
Newark, New Jersey

14752
Electro Cube Inc.
San Gabriel, California

14869
Replaced by 96853

14936
General Instrument Corp.
Semi Conductor Products Group
Hicksville, New York

15636
Elec-Trol Inc.
Saugus, California

15801
Fenwal Electronics Inc.
Div. of Kidde Walter and Co., Inc.
Framingham, Massachusetts

15818
Teledyne Semiconductors, formerly
Amelco Semiconductor
Mountain View, California

15849
Litton Systems Inc. Useco Div.
formerly Useco Inc.
Van Nuys, California

15898
International Business
Machines Corp.
Essex Junction, Vermont

15909
Replaced by 14140

16258
Space-Lok Inc.
Burbank, California

16299
Corning Glass
Electronic Components Div.
Raleigh, North Carolina

16332
Replaced by 28478

16473
Cambridge Scientific Ind.
Div. of Chemed Corporation
Cambridge, Maryland

16742
Paramount Plastics Fabricators, Inc.
Downey, California

16758
Delco Electronics
Div. of General Motors Corp.
Kokomo, Indiana

17001
Replaced by 71468

17069
Circuit Structures Lab.
Burbank, California

17338
High Pressure Eng. Co., Inc.
Oklahoma City, Oklahoma

17545
Atlantic Semiconductors, Inc.
Asbury Park, New Jersey

17856
Siliconix, Inc.
Santa Clara, California

17870
Replaced by 14140

18178
Vactec Inc.
Maryland Heights, Missouri

18324
Signetics Corp.
Sunnyvale, California

18612
Vishay Resistor Products Div.
Vishay Intertechnology Inc.
Malvern, Pennsylvania

18736
Voltronics Corp.
Hanover, New Jersey

18927
G T E Sylvania Inc.
Precision Material Group
Parts Division
Titusville, Pennsylvania

19451
Perine Machinery & Supply Co.
Seattle, Washington

19701
Electro-Midland Corp.
Mepco-Electra Inc.
Mineral Wells, Texas

20584
Enochs Mfg. Inc.
Indianapolis, Indiana

20891
Self-Organizing Systems, Inc.
Dallas, Texas

21604
Buckeye Stamping Co.
Columbus, Ohio

21845
Solitron Devices Inc.
Transistor Division
Riveria Beach, Florida

22767
ITT Semiconductors
Palo Alto, California

23050
Product Comp. Corp.
Mount Vernon, New York

23732
Tracor Inc.
Rockville, Maryland

23880
Stanford Applied Engrng.
Santa Clara, California

23936
Pamotor Div., Wm. J. Purdy Co.
Burlingame, California

24248
Replaced by 94222

24355
Analog Devices Inc.
Norwood, Massachusetts

24655
General Radio
Concord, Massachusetts

24759
Lenox-Fugle Electronics Inc.
South Plainfield, New Jersey

25088
Siemen Corp.
Isilen, New Jersey

25403
Amperex Electronic Corp.
Semiconductor &
Micro-Circuits Div.
Slatersville, Rhode Island

27014
National Semiconductor Corp.
Santa Clara, California

27264
Molex Products
Downers Grove, Illinois

28213
Minnesota Mining & Mfg. Co.
Consumer Products Div.
St. Paul, Minnesota

28425
Serv-/-Link formerly
Bohannan Industries
Fort Worth, Texas

28478
Deltrol Controls Div.
Deltrol Corporation
Milwaukee, Wisconsin

28480
Hewlett Packard Co. Corporate H.Q.
Palo Alto, California

28520
Heyman Mfg. Co.
Kenilworth, New Jersey

29083
Monsanto, Co., Inc.
Santa Clara, California

29604
Stackpole Components Co.
Raleigh, North Carolina

30148
A B Enterprise Inc.
Ahoskie, North Carolina

30323
Illinois Tool Works, Inc.
Chicago, Illinois

31091
Optimax Inc.
Colmar, Pennsylvania

32539
Mura Corp.
Great Neck, New York

32767
Griffith Plastic Corp.
Burlingame, California

32879
Advanced Mechanical Components
Northridge, California

32897
Erie Technological Products, Inc.
Frequency Control Div.
Carlisle, Pennsylvania

32997
Bourns Inc.
Trimpot Products Division
Riverside, California

33173
General Electric Co.
Products Dept.
Owensboro, Kentucky

Federal Supply Codes for Manufacturers (Continued)

34333
Silicon General
Westminister, California

34335
Advanced Micro Devices
Sunnyvale, California

34802
Electromotive Inc.
Kenilworth, New Jersey

37942
Mallory, P.R. & Co., Inc.
Indianapolis, Indiana

42498
National Radio
Melrose, Massachusetts

43543
Nytronics Inc.
Transformer Co. Div.
Geneva, New York

44655
Ohmite Mfg. Co.
Skokie, Illinois

49671
RCA Corp.
New York, New York

49956
Raytheon Company
Lexington, Massachusetts

50088
Mostek Corp.
Carrollton, Texas

50579
Litronix Inc.
Cupertino, California

51605
Scientific Components Inc.
Linden, New Jersey

53021
Sangamo Electric Co.
Springfield, Illinois

54294
Cutler-Hammer Inc. formerly
Shallcross, A Cutter-Hammer Co.
Selma, North Carolina

55026
Simpson Electric Co.
Div. of Am. Gage and Mach. Co.
Elgin, Illinois

56289
Sprague Electric Co.
North Adams, Massachusetts

58474
Superior Electric Co.
Bristol, Connecticut

60399
Torin Corp, formerly
Torrington Mfg. Co.
Torrington, Connecticut

63743
Ward Leonard Electric Co., Inc.
Mount Vernon, New York

64834
West Mfg. Co.
San Francisco, Californai

65092
Weston Instruments Inc.
Newark, New Jersey

66150
Winslow Tele-Tronics Inc.
Eaton Town, New Jersey

70485
Atlantic India Rubber Works
Chicago, Illinois

70563
Amperite Company
Union City, New Jersey

70903
Belden Corp.
Geneva, Illinois

71002
Birnbach Radio Co., Inc.
Freeport, LI New York

71400
Bussmann Mfg.
Div. of McGraw-Edison Co.
Saint Louis, Missouri

71450
CTS Corp.
Elkhart, Indiana

71468
ITT Cannon Electric Inc.
Santa Ana, California

71482
Clare, C.P. & Co.
Chicago, Illinois

71590
Centrelab Electronics
Div. of Globe Union Inc.
Milwaukee, Wisconsin

71707
Coto Coil Co., Inc.
Providence, Rhode Island

71744
Chicago Miniature Lamp Works
Chicago, Illinois

71785
TRW Electronics Components
Cinch Connector Operations Div.
Elk Grove Village, Chicago, Illinois

72005
Driver, Wilber B., Co.
Newark, New Jersey

72092
Replaced by 06980

72136
Electro Motive Mfg. Co.
Williamantic, Connecticut

72259
Nytronics Inc.
Pelham Manor, New Jersey

72619
Dialight Div.
Amperex Electronic Corp.
Brooklyn, New York

72653
G.C. Electronics
Div. of Hydrometals, Inc.
Brooklyn, New York

72665
Replaced by 90303

72794
Dzus Fastener Co., Inc.
West Islip, New York

72928
Gulton Ind. Inc.
Gudeman Div.
Chicago, Illinois

72982
Erie Tech. Products Inc.
Erie, Pennsylvania

73138
Beckman Instruments Inc.
Helipot Division
Fullerton, California

73293
Hughes Aircraft Co.
Electron Dynamics Div.
Torrence, California

73445
Amperex Electronic Corp.
Hicksville, LI, New York

73559
Carling Electric Inc.
West Hartford, Connecticut

73586
Circle F Industries
Trenton, New Jersey

73734
Federal Screw Products, Inc.
Chicago, Illinois

73743
Fischer Special Mfg. Co.
Cincinnati, Ohio

73899
JFD Electronics Co.
Components Corp
Brooklyn, New York

73949
Guardian Electric Mfg. Co.
Chicago, Illinois

74199
Quan Nichols Co.
Chicago, Illinois

74217
Radio Switch Corp.
Marlboro, New Jersey

74276
Signalite Div.
General Instrument Corp.
Neptune, New Jersey

74306
Piezo Crystal Co.
Carlisle, Pennsylvania

74542
Hoyt Elect. Instr. Works
Penacook, New Hampshire

74970
Johnson E.F., Co.
Waseca, Minnesota

75042
TRW Electronics Components
IRC Fixed Resistors
Philadelphia, Pennsylvania

75376
Kurz-Kasch Inc.
Dayton, Ohio

75378
CTS Knights Inc.
Sandwich, Illinois

75382
Kulka Electric Corp.
Mount Vernon, New York

75915
Littlefuse Inc.
Des Plaines, Illinois

76854
Oak Industries Inc.
Switch Div.
Crystal Lake, Illinois

77342
AMF Inc.
Potter & Brumfield Div.
Princeton, Indiana

77638
General Instrument Corp.
Rectifier Division
Brooklyn, New York

77969
Rubbercraft Corp. of CA. LTD.
Torrance, California

78189
Shakeproof
Div. of Illinois Tool Works Inc.
Elgin, Illinois

78277
Sigma Instruments, Inc.
South Braintree, Massachusetts

78488
Stackpole Carbon Co.
Saint Marys, Pennsylvania

78553
Eaton Corp. Engineered
Fastener Div.
Tinnerman Plant
Cleveland, Ohio

79136
Waldes Kohinoor Inc.
Long Island City, New York

79497
Western Rubber Company
Goshen, Indiana

79963
Zierick Mfg. Corp.
Mt. Kisko, New York

80031
Electro-Midland Corp., Mepco Div.
A North American Phillips Co.
Morristown, New Jersey

80145
LFE Corp., Process Control Div.
formerly API Instrument Co.
Chesterland, Ohio

80183 - use 56289
Sprague Products
North Adams, Massachusetts

80294
Bourns Inc., Instrument Div.
Riverside, California

80583
Hammarlund Mfg. Co., Inc.
Red Bank, New Jersey

80640
Stevens, Arnold Inc.
South Boston, Massachusetts

81073
Grayhill, Inc.
La Grange, Illinois

81312
Winchester Electronics
Div. of Litton Industries Inc.
Oakville, Connecticut

81439
Therm-O-Disc Inc.
Mansfield, Ohio

81483
International Rectifier Corp.
Los Angeles, California

81590
Korry Mfg. Co.
Seattle, Washington

81741
Chicago Lock Co.
Chicago, Illinois

82305
Palmer Electronics Corp.
South Gate, California

82389
Switchcraft Inc.
Chicago, Illinois

82415
North American Phillips
Controls Corp.
Frederick, Maryland

82872
Roanwell Corp.
New York, New York

82877
Rotron Inc.
Woodstock, New York

82879
ITT Royal Electric Div.
Pawtucket, Rhode Island

83003
Varo Inc.
Garland, Texas

83058
Carr Co., The United Can Div.
of TRW
Cambridge, Massachusetts

83298
Bendix Corp.
Electric Power Division
Eatontown, New Jersey

83330
Smith, Herman H., Inc.
Brooklyn, New York

83478
Rubbercraft Corp. of America, Inc.
West Haven, Connecticut

83594
Burroughs Corp.
Electronic Components Div.
Plainfield, New Jersey

83740
Union Carbide Corp.
Battery Products Div.
formerly Consumer Products Div.
New York, New York

84171
Arco Electronics
Great Neck, New York

84411
TRW Electronic Components
TRW Capacitors
Ogallala, Nebraska

84613
Fuse Indicator Corp.
Rockville, Maryland

84682
Essex International Inc.
Industrial Wire Div.
Peabody, Massachusetts

86577
Precision Metal Products,
of Malden Inc.
Stoneham, Massachusetts

86684
Radio Corp. of America
Electronic Components Div.
Harrison, New Jersey

86928
Seastrom Mfg. Co., Inc.
Glendale, California

87034
Illuminated Products Inc.
Subsidiary of Oak Industries Inc.
Anahiem, California

88219
Gould Inc.
Industrial Div.
Trenton, New Jersey

88245
Litton Systems Inc.
Useco Div.
Van Nuys, California

88419
Cornell-Dubilier Electronic Div.
Federal Pacific Co.
Fuquay-Varian, North Carolina

88486
Plastic Wire & Cable
Jewitt City, Connecticut

88690
Replaced by 04217

89536
Fluke, John Mfg. Co., Inc.
Seattle, Washington

89730
G.E. Co., Newark Lamp Works
Newark, New Jersey

90201
Mallory Capacitor Co. Div of
P.R. Mallory Co., Inc.
Indianapolis, Indiana

90211 - use 56365
Square D Co.
Chicago, Illinois

90215
Best Stamp & Mfg. Co.
Kansas City, Missouri

90303
Mallory Battery Co.
Div. of Mallory Co., Inc.
Tarrytown, New York

91094
Essex International Inc.
Suglex/IWP Div.
Newmarket, New Hampshire

91293
Johanson Mfg. Co.
Boonton, New Jersey

91407
Replaced by 58474

91502
Associated Machine
Santa Clara, California

91506
Augat Inc.
Attleboro, Massachusetts

91637
Dale Electronics Inc.
Columbus, Nebraska

91662
Elco Corp.
Willow Grove, Pennsylvania

91737 - use 71468
Gremar Mfg. Co., Inc.
ITT Cannon/Gremar
Santa Ana, California

91802
Industrial Devices, Inc.
Edgewater, New Jersey

91833
Keystone Electronics Corp.
New York, New York

91836
King's Electronics Co., Inc.
Tuckahoe, New York

91929
Honeywell Inc.
Micro Switch Div.
Freeport, Illinois

91934
Miller Electric Co., Inc.
Div of Aunet
Woonsocket, Rhode Island

92194
Alpha Wire Corp.
Elizabeth, New Jersey

93332
Sylvania Electric Products
Semiconductor Products Div.
Woburn, Massachusetts

94145
Replaced by 49956

94154 - use 94988
Wagner Electric Corp.
Tung-Sol Div.
Newark, New Jersey

94222
Southco Inc. formerly
South Chester Corp.
Lester, Pennsylvania

95146
Alco Electronic Products Inc.
Lawrence, Massachusetts

95263
Leecraft Mfg. Co.
Long Island City, New York

95264
Replaced by 98278

95275
Vitramon Inc.
Bridgeport, Connecticut

95303
RCA Corp.
Receiving Tube Div.
Cincinnati, Ohio

95348
Gordo's Corp.
Bloomfield, New Jersey

95354
Methode Mfg. Corp.
Rolling Meadows, Illinois

95712
Bendix Corp.
Electrical Components Div.
Microwave Devices Plant
Franklin, Indiana

95987
Weckesser Co. Inc.
Chicago, Illinois

96733
San Fernando Electric Mfg. Co.
San Fernando, California

96853
Gulton Industries Inc.
Measurement and Controls Div.
formerly Rustrak Instruments Co.
Manchester, New Hampshire

96881
Thomson Industries, Inc.
Manhasset, New York

97540
Master Mobile Mounts
Div. of Whitehall Electronics Corp.
Ft. Meyers, Florida

97913
Industrial Electronic Hdware Corp.
New York, New York

97945
Penwalt Corp.
SS White Industrial Products Div.
Piscataway, New Jersey

97966
Replaced by 11358

98094
Replaced by 49956

98159
Rubber-Teck, Inc.
Gardena, California

98278
Malco A Microdot Co., Inc.
Connector & Cable Div.
Pasadena, California

98291
Sealectro Corp.
Mamaroneck, New York

98388
Royal Industries
Products Div.
San Diego, California

98743
Replaced by 12749

98925
Replaced by 14433

99120
Plastic Capacitors, Inc.
Chicago, Illinois

99217
Bell Industries Elect. Comp. Div.
formerly Southern Elect. Div.
Burbank, California

99392
STM
Oakland, California

99515
ITT Jennings Monrovia Plant
Div. of ITT Jennings formerly
Marshall Industries Capacitor Div.
Monrovia, California

99779 - use 29587
Bunker-Ramo Corp.
Barnes Div.
Landsdowne, Pennsylvania

99800
American Precision Industries Inc.
Delevan Division
East Aurora, New York

99942
Centrelab Semiconductor
Centrelab Electronics Div. of
Globe-Union Inc.
El Monte, California

Toyo Electronics
(R-Ohm Corp.)
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National Connector
Minneapolis, Minnesota

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Tel. (412) 892-2953

TEXAS
Austin
Barnhill Associates, Inc.
1200 Barton Hill, No. 197
Zip: 78704
Tel. (512) 444-2377

Dallas
Barnhill Associates, Inc.
908 Business Parkway
Richardson, TX 75080
Tel. (214) 231-2573

Houston
Barnhill Associates, Inc.
10606 Hempstead Highway
Suite 132
Zip: 77092
Tel. (713) 688-9971

VIRGINIA
Williamsburg
BCS Associates, Inc.
107 Rich Neck Road
Zip: 23185
Tel. (804) 877-4053

WASHINGTON
Benton City
Showalter Instruments, Inc.
P.O. Box 828
Zip: 99320
Tel. (509) 588-3472

Seattle
Showalter Instruments, Inc.
1521 - 130th N.E.
Bellevue, WA 98005
Tel. (206) 455-4922

WASHINGTON, D.C.
Baltimore
John Fluke Mfg. Co., Inc.
11501 Huff Court
Kensington, MD 20795
Tel. (301) 881-3370

For U.S. areas not listed, contact the regional office nearest you or John Fluke Mfg. Co., Inc., Mountlake Terrace, WA.

Canada

ALBERTA
Calgary
Allan Crawford Assoc., Ltd.
3829 - 12th Street N.E.
Zip: T2E 6M5
Tel. (403) 276-9658

BRITISH COLUMBIA
North Vancouver
Allan Crawford Assoc., Ltd.
116 E. Third St., Suite 203
Zip: V7L 1E6
Tel. (604) 980-4831

NOVA SCOTIA
Halifax
Allan Crawford Assoc., Ltd.
Suite 201, Townsend Pl.
800 Windmill Rd.
Burnside Industrial Park
Dartmouth, NS
Zip: B3B 1L1
Tel. (902) 469-7865

ONTARIO
Toronto
Allan Crawford Assoc., Ltd.
6427 Northam Drive
Mississauga, Ont L4V 1J5
Tel. (416) 678-1500

Ottawa
Allan Crawford Assoc., Ltd.
1299 Richmond Road
Zip: K2B 7Y4
Tel. (613) 829-9651

QUEBEC
Montreal
Allan Crawford Assoc., Ltd.
1330 Marie Victorian Blvd. E.
Longueuil, P.Q. J4G 1A2
Tel. (514) 670-1212

For Canadian areas not listed, contact the regional office nearest you or Allan Crawford Assoc., Ltd., Mississauga, Ontario.

All of the above Fluke Sales Offices carry local stocks of low-cost Digital Multimeters (Models 8000A, 8030A, 8040A), Counters (Model 1900A), Digital Thermometers (Models 2160A, 2170A, 2165A, 2175A) and the Universal Temperature Probe (Model 80T-150). These same products are available from the following distributors:

Brownell Electronics
Atlanta, GA (404) 762-5181
Charlotte, NC (704) 394-4341
Memphis, TN (901) 323-8554
Nashville, TN (615) 889-8230
Orlando, FL (305) 843-6770
Mobile, AL (205) 479-5405

The Mancib Company
Boston, MA (617) 272-9450
Middletown, CT (203) 346-6646

Elmar Electronics
San Francisco, CA (415) 961-3611
Denver, CO (303) 287-9611

Pioneer-Standard
Cleveland, OH (216) 587-3600
Dayton, OH (513) 236-9900
Indianapolis, IN (317) 849-7300
Pittsburgh, PA (412) 782-2300
Detroit, MI (313) 525-1800

Liberty Electronics
El Segundo, CA (213) 322-8100
San Diego, CA (714) 565-9171
Phoenix, AZ (602) 257-1272
Seattle, WA (206) 763-8200
Albuquerque, NM (505) 299-8293
Beaverton, OR (503) 644-4783

Section 8
Schematic Diagrams

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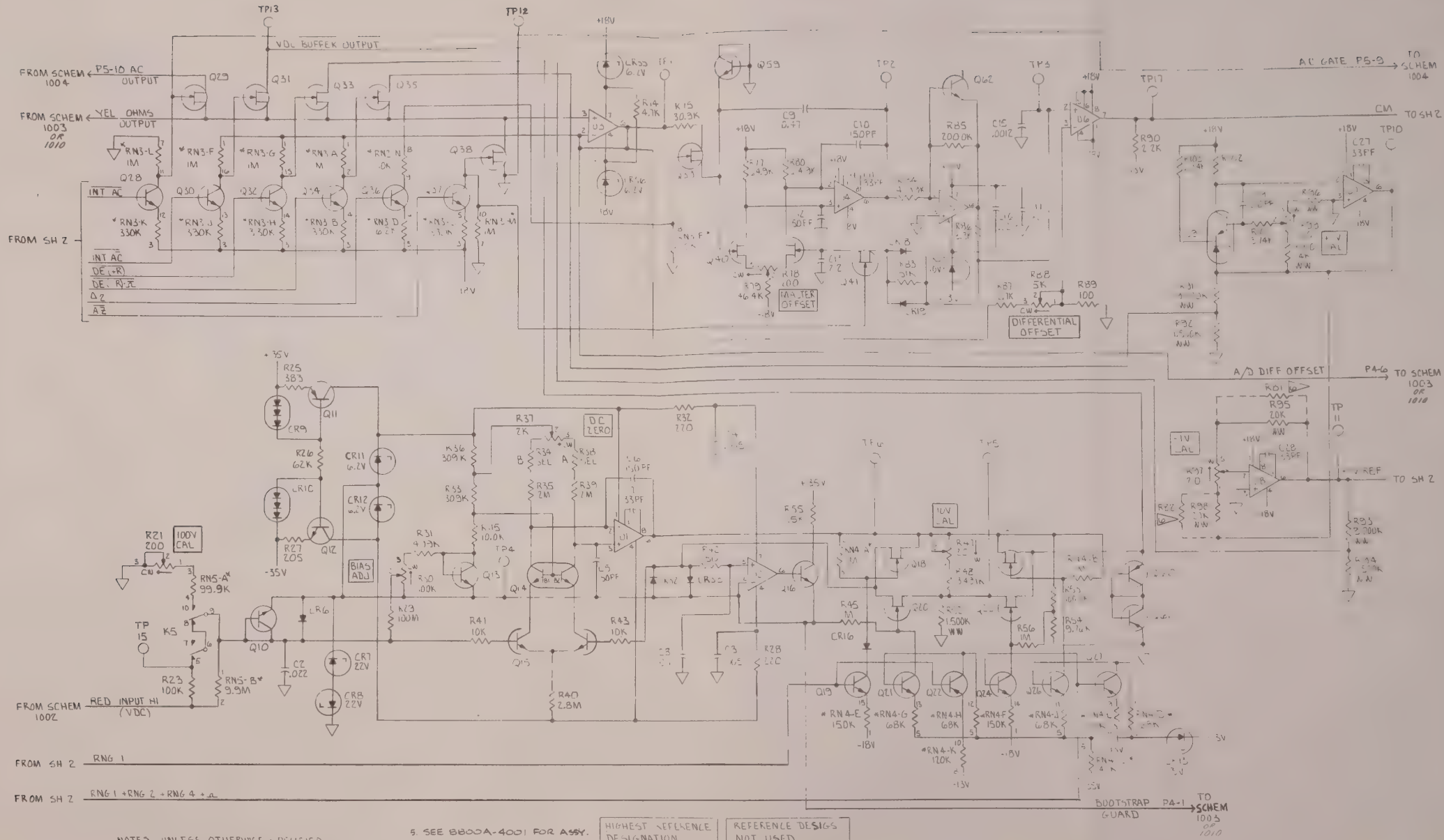
8-6	Data Output Unit (Option –02)	8800A-1005	8-9



NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTANCE VALUES IN OHMS
2. ALL CAPACITANCE VALUES IN MICROFARADS
3. CONNECT -15V TO U11-1, 4, 13 & 14, U12-16, U13-1, 8, 16, U14-14, U15-14, U16-16, U20-16.
4. CONNECT -18V TO U1-4, -8, -16, U12-8 & 12, U15-8, U14-7, U15-7, U16-8, U20-6, -1 & 8.
5. SEE 8800A-4001 FOR ASSY.

FACTORY SELECTED

HIGHEST REFERENCE DESIGNATION		
C33	CR39	K5
Q63	R121	S12
T1	TP11	U20
Y1		

REFERENCE DESIGS NOT USED
C1, 14, 30
CR1-5, 14 15 17 21 28
K1-4. Q1-9, 17, 42
R1-20, 22, 24, 44, 46, 43-51, 57 73, 76, 104-112. S1-10. U10.

FIGURE 8-1 (1 of 2) MAIN PCB ASSEMBLY
8800A-1001
4/77

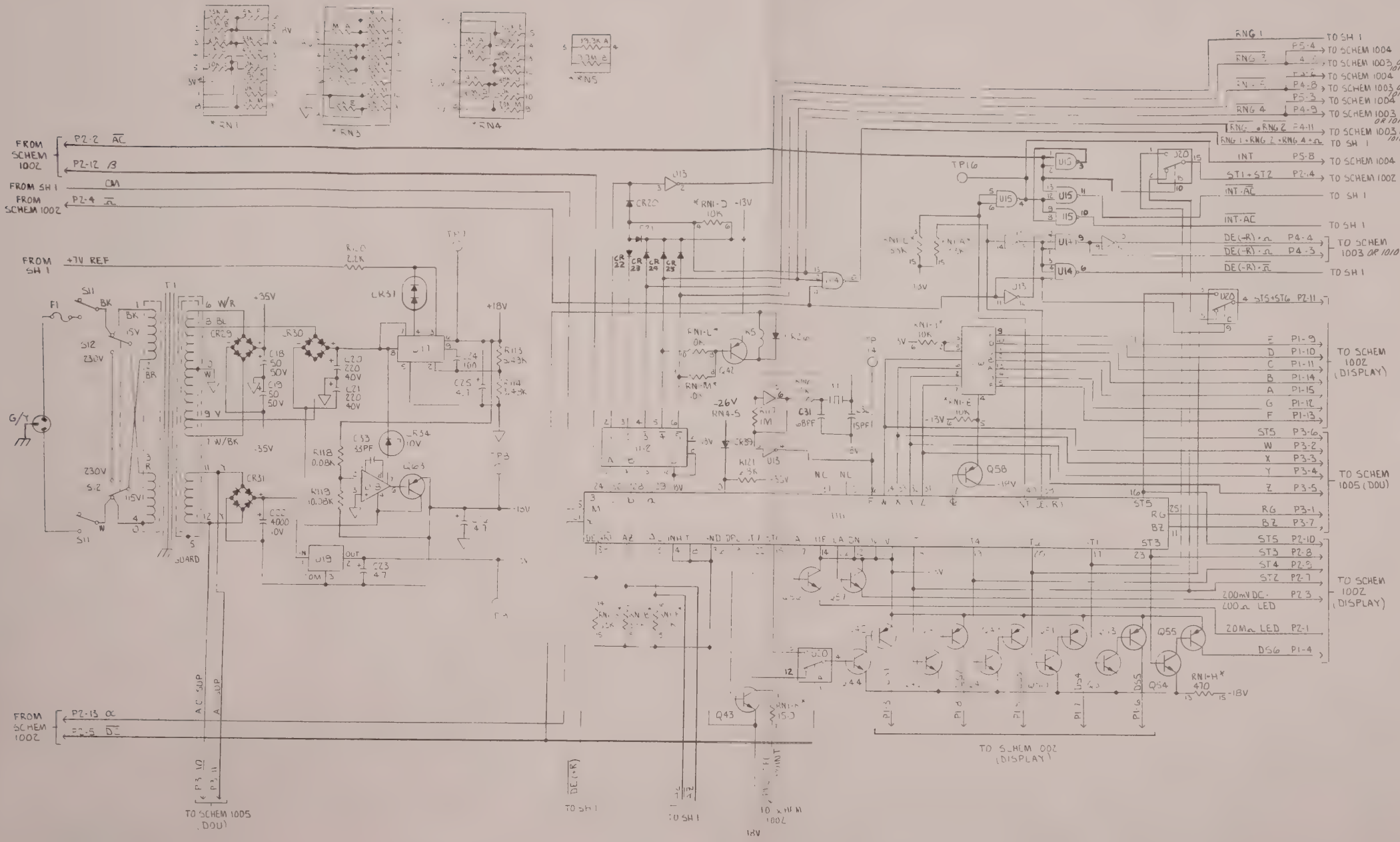


FIGURE 8-1 (2 of 2) MAIN PCB ASSEMBLY
8800A-1001

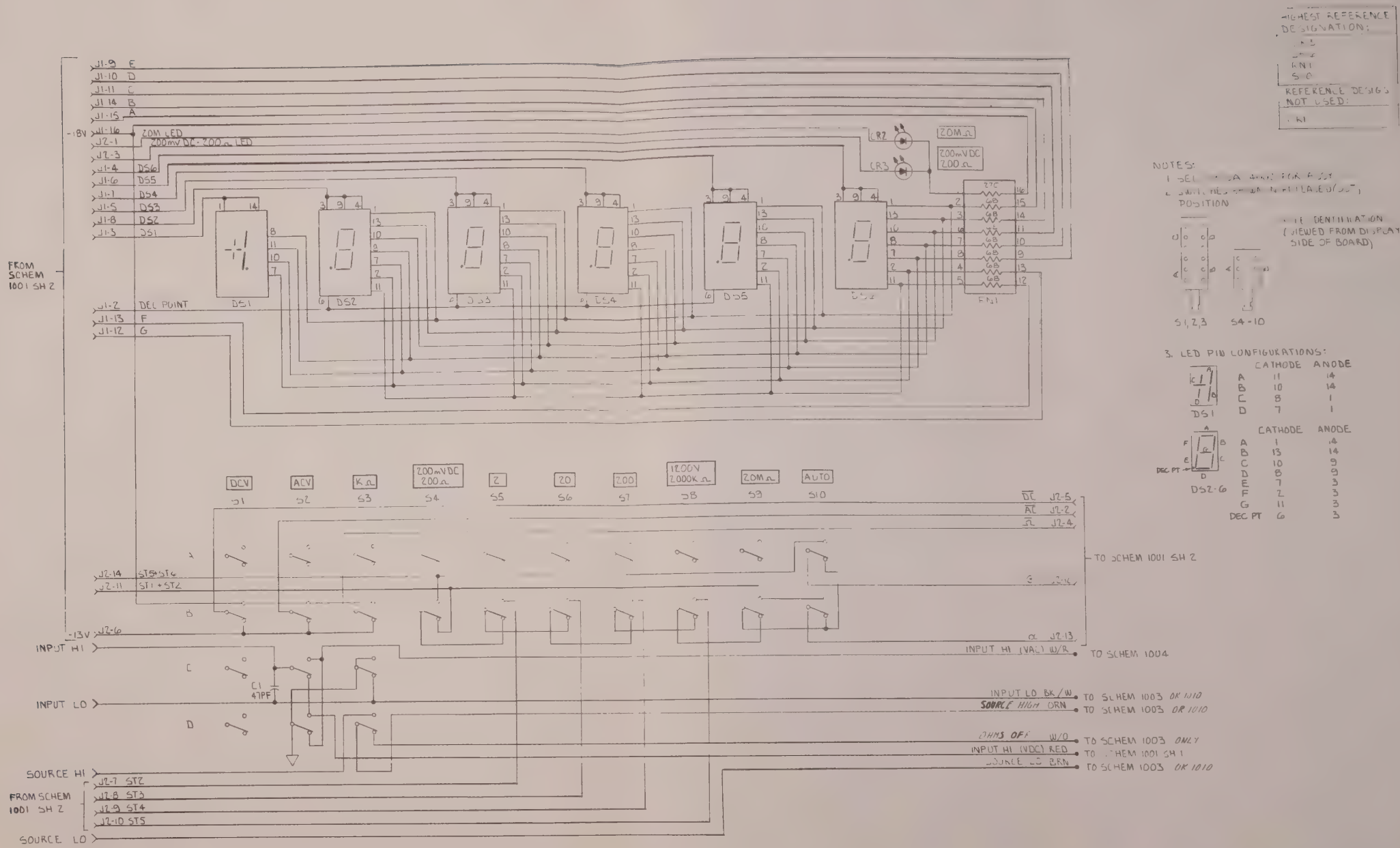
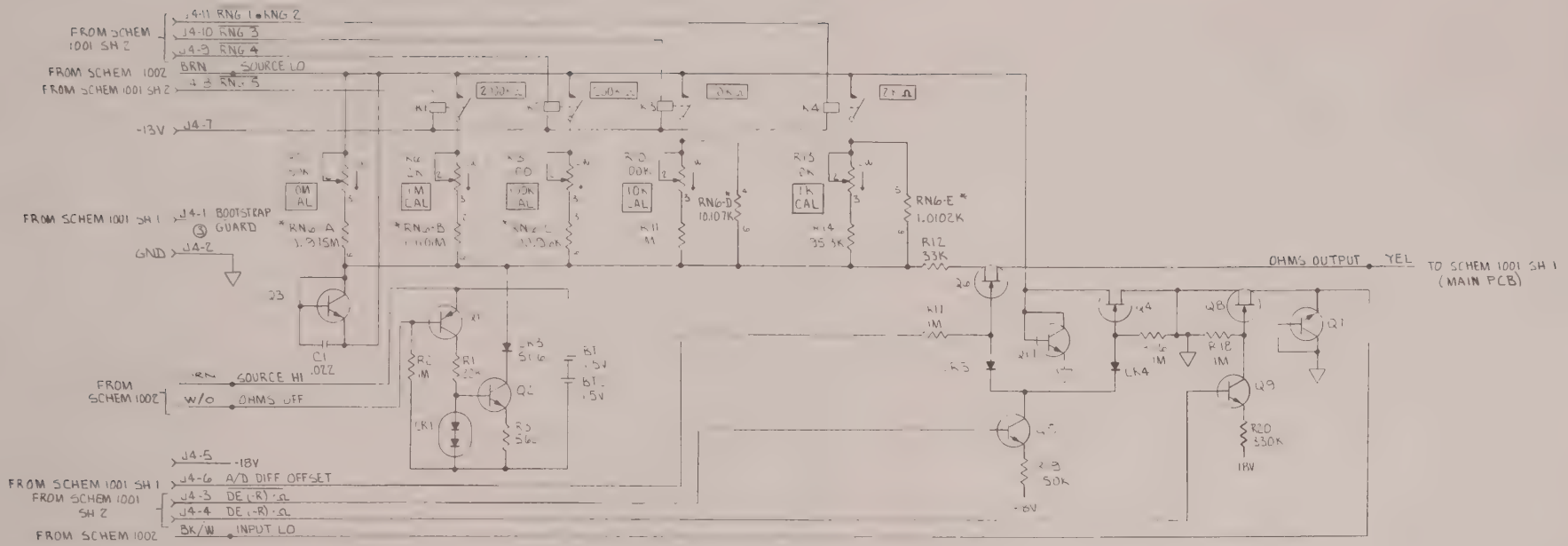
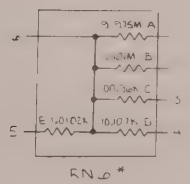


FIGURE 8-2 DISPLAY PCB ASSEMBLY
8800A-1002





HIGHEST REFERENCE DESIGNATION:		
BT2	K4	RN6
C1	Q11	
CR5	R20	

REFERENCE DESIGS NOT USED:
CR2 RN1-5
Q2-Q6
K2,3

NOTES UNLESS OTHERWISE SPECIFIED
1. ALL RESISTANCE VALUES IN OHMS
2. ALL CAPACITANCE VALUES IN MICROFARADS
③ BUFFER BOOTSTRAP SIGNAL IS USED AS A GUARD IN THE OHMS CONVERTER
4 SEE 8800A-4003 FOR ASSY.

FIGURE 8-3 OHMS CONVERTER ASSEMBLY 8800A-1003

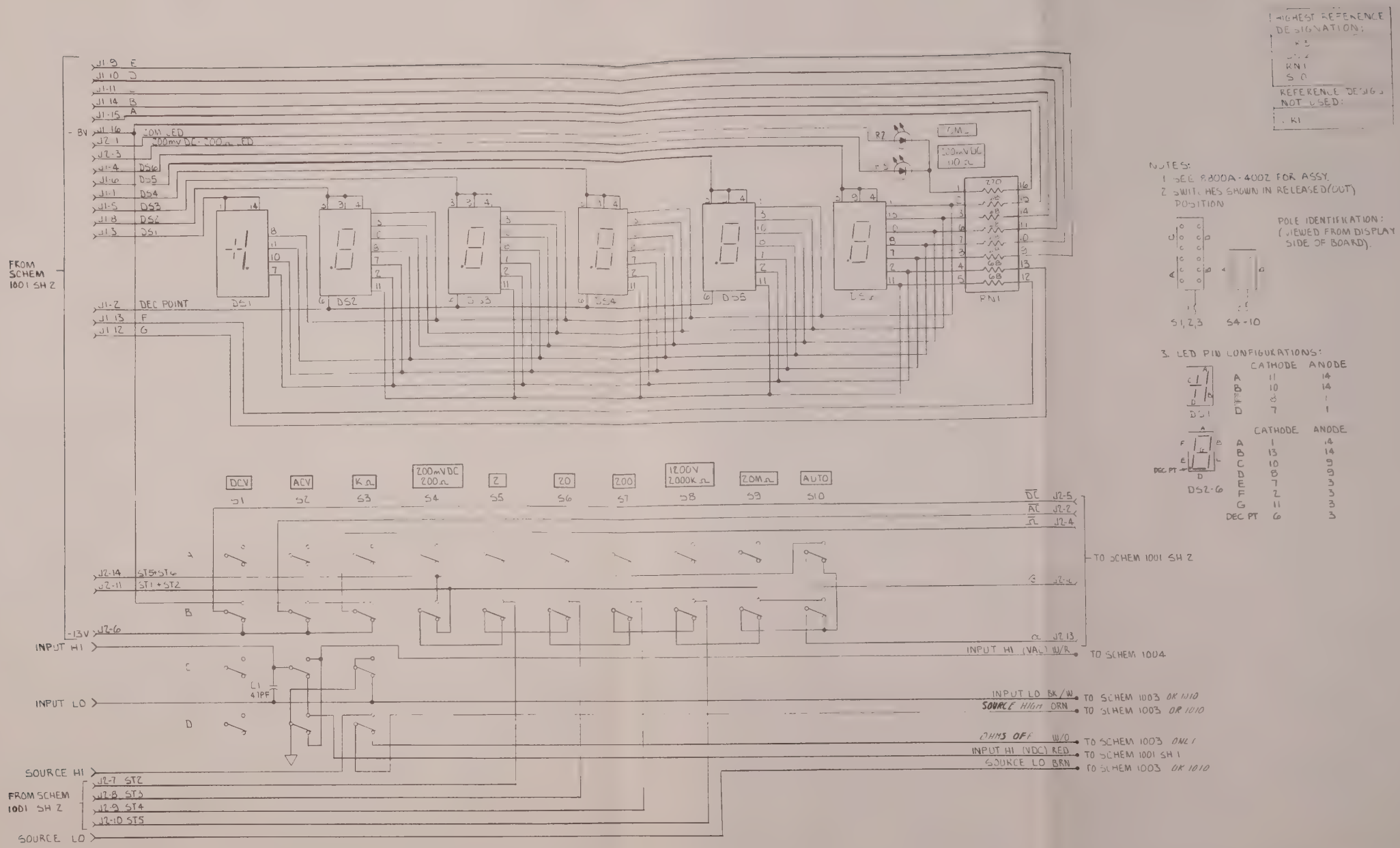
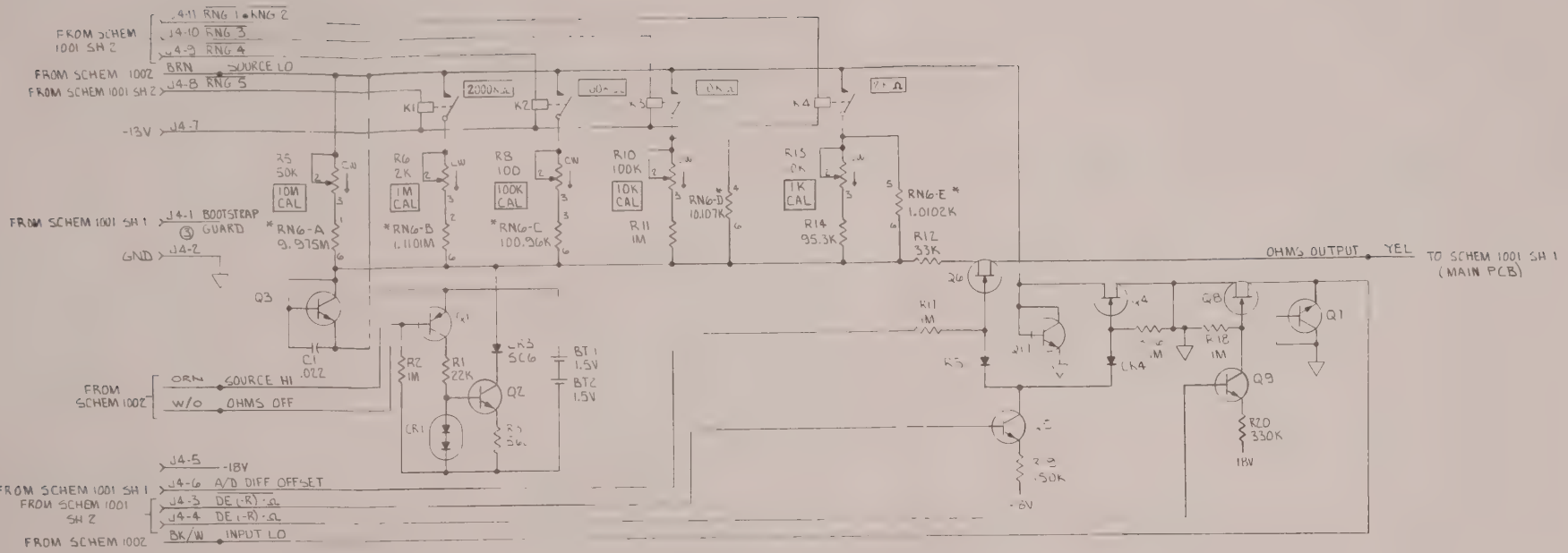
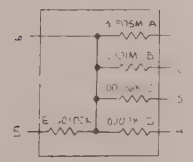


FIGURE 8-2 DISPLAY PCB ASSEMBLY 8800A-1002





HIGHEST REFERENCE DESIGNATION:		
BT2	K4	RN6
C1	Q11	
CR5	R20	

REFERENCE DESIGNATORS NOT USED:	
CR2	RN1-5
Q10-16	
R4,7&9	

NOTES UNLESS OTHERWISE SPECIFIED
1. ALL RESISTANCE VALUES IN OHMS
2. ALL CAPACITANCE VALUES IN MICROFARADS
③ BUFFER BOOTSTRAP SIGNAL IS USED AS A GUARD IN THE OHMS CONVERTER
4 SEE 8800A-4003 FOR ASSY.

FIGURE 8-3 OHMS CONVERTER ASSEMBLY 8800A-1003

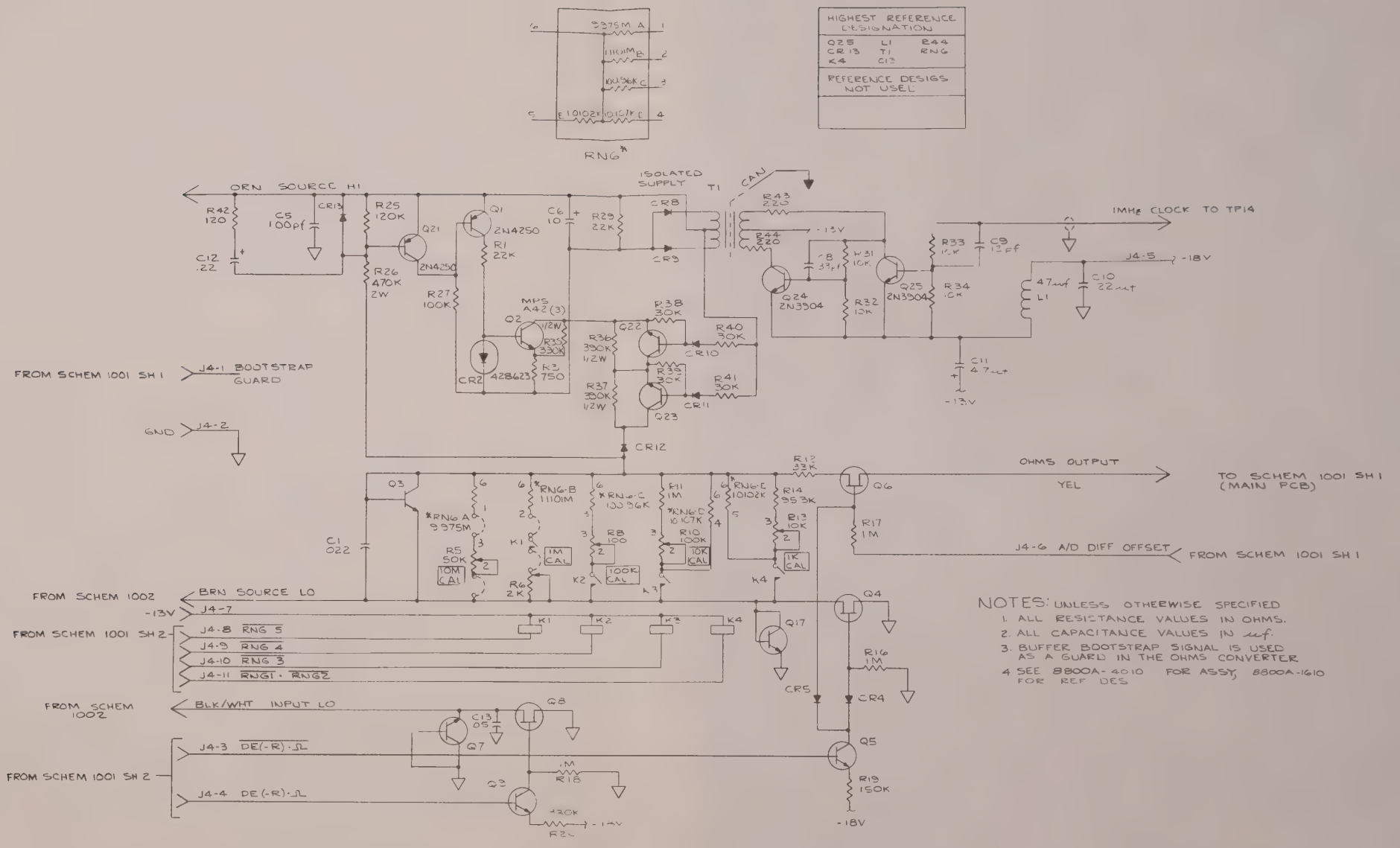
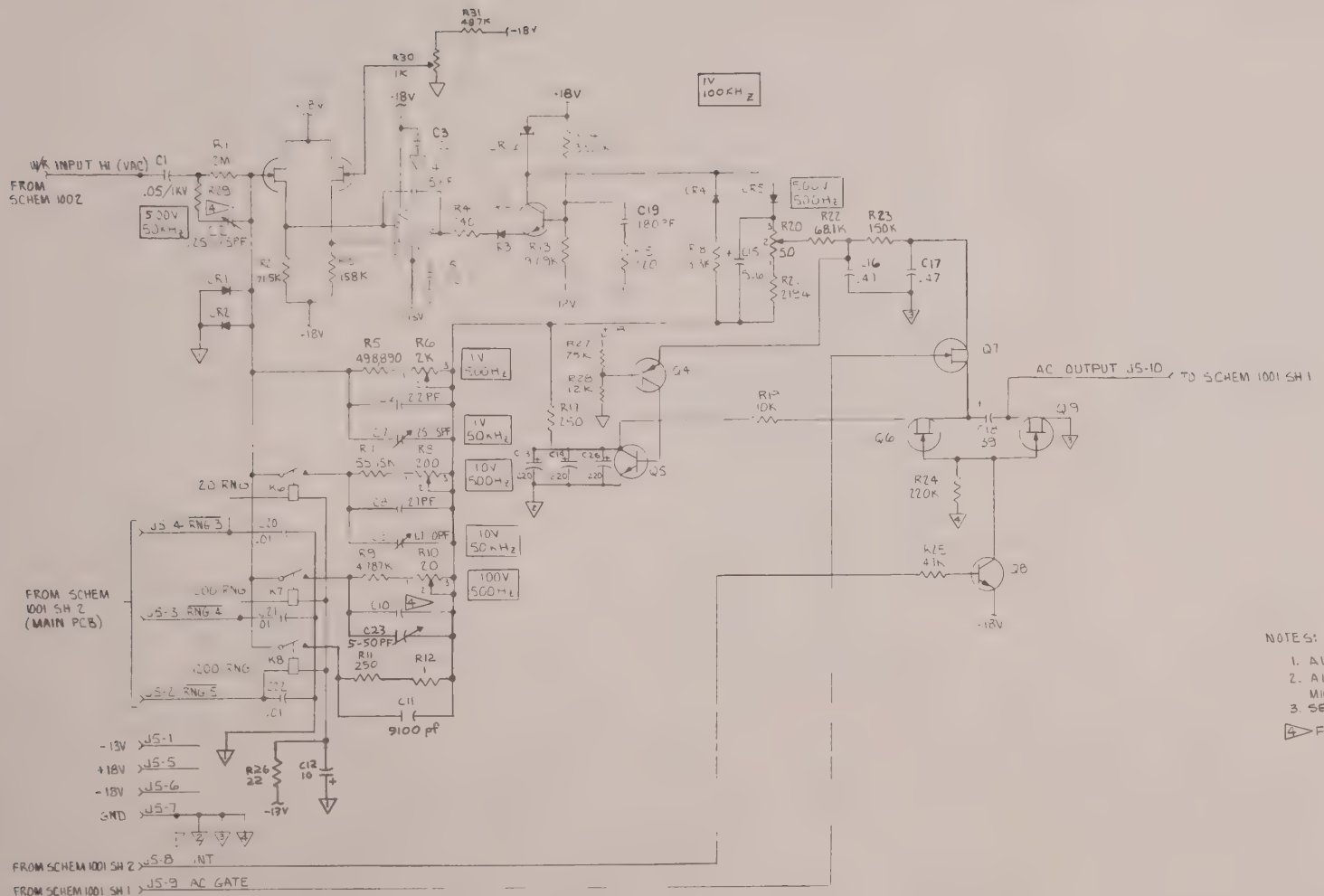


FIGURE 8-4 OHMS CONVERTER II ASSEMBLY 8800A-1010



HIGHEST REFERENCE DESIGNATION	
C26	Q11
R6	R35
K8	U1

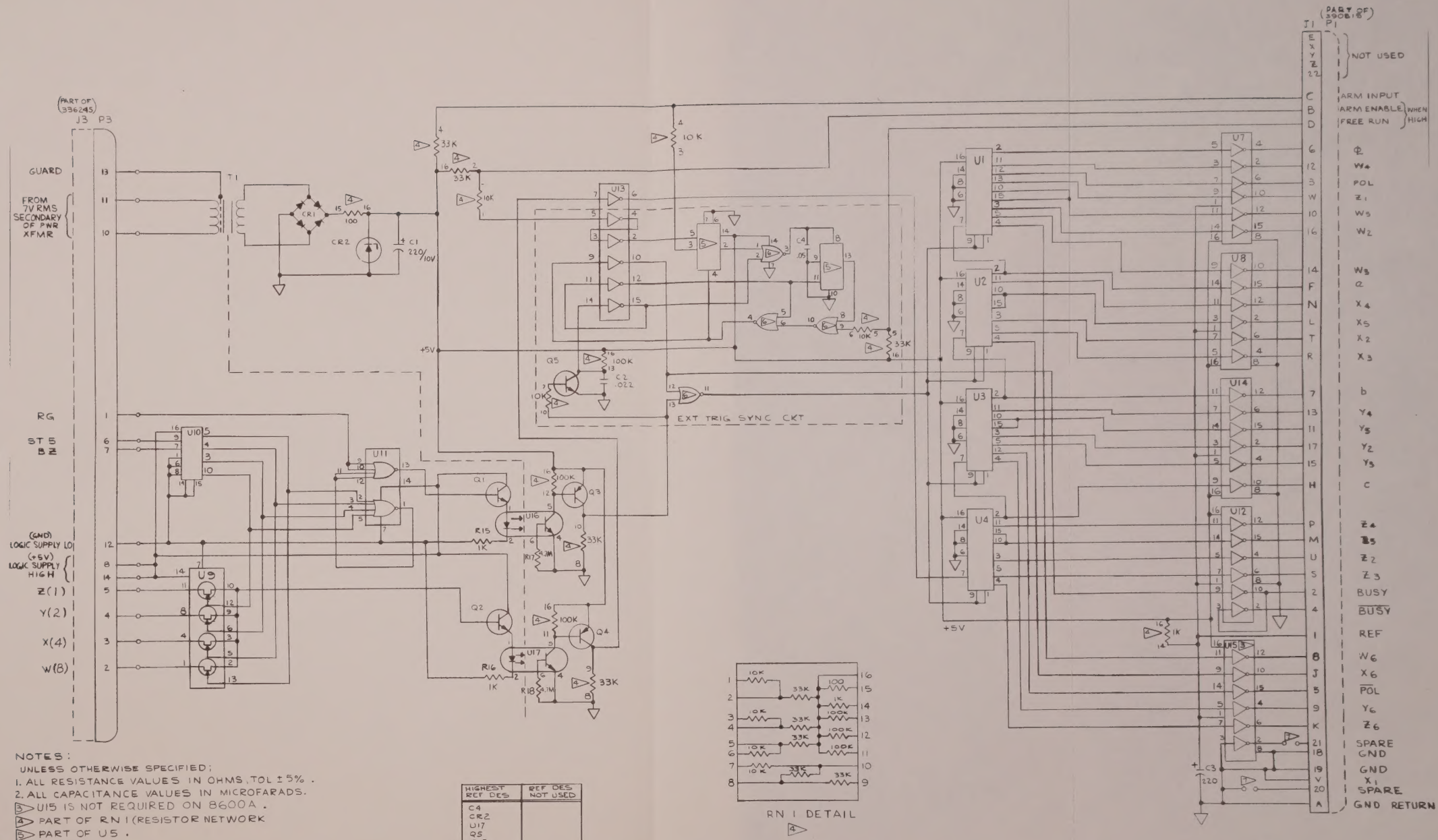
REFERENCE DESIGS NOT USED
K1-K5 R16,32-35
C24
Q3,10,11

NOTES: UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTANCE VALUES ARE IN OHMS,
2. ALL CAPACITANCE VALUES ARE IN MICROFARADS
3. SEE 8800A-4014 FOR ASSY, 8800A-1614 FOR REF DES.

4 FACTORY SELECTED COMPONENTS:
R29 = 4.7K NOMINAL
C10 = 330PF NOMINAL

FIGURE 8-5 AC CONVERTER ASSEMBLY 8800A-1014



NOTES:
UNLESS OTHERWISE SPECIFIED;
1. ALL RESISTANCE VALUES IN OHMS, TOL ± 5%.
2. ALL CAPACITANCE VALUES IN MICROFARADS.
5 U15 IS NOT REQUIRED ON 8600A.
4 PART OF RN 1 (RESISTOR NETWORK
6 PART OF U5.
6 PART OF U6.
7 JUMPER AS REQUIRED
8. SEE 8800A-4005 FOR ASSY.

HIGHEST REF DES	REF DES NOT USED
C4	
CR2	
U17	
Q5	
R18	
RN1	
T1	

FIGURE 8-6 DATA OUTPUT UNIT (Option –02)
8800A-1005

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